9 Description of Alternatives

In the Feasibility Study for the Mine Area Operable Unit (USEPA, 2004a), the purpose of which was to develop, screen, and evaluate cleanup alternatives to address impacts to human health and the environment identified in the HHRA, USEPA examined three distinct subareas:

1) the Mine Area residences;

2) the mine buildings, tailings, waste rock, and mine drainage; and

3) Little Clipper Creek downstream of the log dam and upstream of Greenhorn Road.

For each of these subareas, USEPA evaluated several cleanup alternatives as well as a "no action" alternative under which no cleanup would take place (not even land use restrictions), and an "institutional controls only"alternative under which no physical cleanup would take place but under which access and land use restrictions would be implemented.

A brief description of each remedial alternative considered in each subarea is presented below.

9.1 Mine Area Residences Alternatives

Remedial alternatives for the Mine Area residences will address any contaminated soil present in the immediate vicinity of the four existing residences. These alternatives specifically apply to areas of parcels 39-160-21, 39-160-16, 39-160-25, and 39-160-30.

9.1.1 Alternative 1-1 – No Action

The NCP requires USEPA to consider a no action alternative and to evaluate the risk to the public if no action were taken. The No-Action Alternative also provides a baseline for comparison with other remedial alternatives under consideration. In this alternative, no remedial actions would be taken to address the contaminated soil present around the residences.

9.1.2 Alternative 1-2 – Institutional Controls Only

To limit human exposure to contaminated soil (ecological exposure would not be reduced by this alternative), surface land use contols would be implemented, to prohibit residential use of parcels 39-160-25 and 39-160-30 (USEPA's response action taken in April 2003 resulted in these residences being vacated due to short-term risks to human health). Land use controls would take the form of deed restrictions prohibiting residential use. The residence which currently occupies parcel 39-160-25 would be demolished as part of the response action under certain alternatives (see Section 9.2 below).

Surface land use controls would be implemented for the other two parcels on which residences are currently located, parcels 39-160-21 and 39-160-16. Specifically, no excavation, spreading, or disturbance of surface and subsurface soils would be allowed, and these limitations would be specified in deed restrictions.

Periodic monitoring and inspections would be required indefinitely to verify land use controls.

9.1.3 Alternative 1-3 – Capping Around Residences

Alternative 1-3 would be designed to limit human and ecological exposure to contaminated soil by capping the contaminated soil and implementing land use restrictions.

This alternative assumes that as in Alternative 1-2, parcel 39-160-25 would be subject to deed restrictions entirely prohibiting residential use. The residence which currently occupies parcel 39-160-25 would be demolished as part of the response action under certain alternatives (see Section 9.2 below).

Land use restrictions would be implemented at parcels 39-160-30, 39-160-21, and 39-160-16 to prevent activities that could compromise the soil cover. Prohibited activities would include: excavation, spreading, or disturbance of surface and subsurface soils and would be specified in deed restrictions for these parcels. For alternative development and cost estimation, it was assumed that exposed soil within a distance of 50 feet surrounding the residences would be covered with 2 feet of uncontaminated soil. The soil cover would be seeded to reestablish the existing vegetative cover. The soil needed to construct the cover would be transported from an offsite borrow source and would be subjected to chemical analysis to ensure compliance with the cleanup goals cited in Section 8 above. Periodic monitoring and maintenance would be required indefinitely to verify that the cover remains intact and performs as intended.

9.1.4 Alternative 1-4 – Excavation Around Residences

Alternative 1-4 is designed to protect human and ecological receptors by excavation of contaminated soil at parcels 39-160-30, 39-160-21, and 39-160-16 and allow for unrestriced use of these parcels.

This alternative assumes that as in Alternative 1-2, parcel 39-160-25 would be subject to use restrictions prohibiting residential use. These protective measures would take the form of a deed restriction. The residence which currently occupies parcel 39-160-25 would be demolished as part of the response action under certain alternatives (see Section 9.2 below).

For alternative development and cost estimation, it was assumed exposed soil within a distance of 50 feet surrounding the three remaining residences would be excavated to a depth of 2 feet. The area would be excavated using backhoes and excavators. The excavated area would be backfilled with uncontaminated soil (transported from an offsite borrow source and subjected to chemical analysis to ensure compliance with the cleanup goals cited in Section 8 below) to maintain the grade, and the area would be seeded to reestablish existing vegetation. Under this alternative surface use restrictions (with the exception of restrictions against surface mining uses) would not be necessary for parcels 39-160-30, 39-160-21, and 39-160-16.

Depending on the alternative chosen for the tailings in the mine area (described in Section 9.2), the excavated soil would be: (1) consolidated with the tailings and waste rock pile for regrading or capping; (2) subjected to chemical analysis and disposed of in an appropriate offsite disposal facility; or (3) disposed in an onsite disposal cell.

9.2 Mine Buildings, Tailings, Waste Rock and MineDrainage Alternatives

This section presents the remedial alternatives for the mine buildings, tailings, waste rock and mine drainage at the Mine Area Operable Unit. This alternative specifically pertains to parcel 39-160-25 (which contains the mine buildings, tailings and waste rock piles, and the mine adit); 39-160-27 (which is crossed by the Little Clipper Creek diversion structure), and 39-160-28 (which contains the failed log dam); and 39-160-29 (which contains a gravel roadway leading from the mine south to Tensy Lane). Media targeted by these remedial actions include contaminated tailings, soil, sediment, and surface water. Treatment of mine area seepage is included in Alternatives 2-2 through 2-6. To account for the uncertainty in the final flow rates, the FS presented treatment costs for both a low-flow and a high-flow scenario.

9.2.1 Alternative 2-1 – No Action

As described above in Section 9.1.1, the NCP requires USEPA to consider a no action alternative and to evaluate the risk to the public if no action were taken. The No-Action Alternative also provides a baseline for comparison with other remedial alternatives under consideration. In this alternative, no remedial actions would be taken to control continued migration of contaminants away from the Mine Area source area.

9.2.2 Alternative 2-2 – Surface Soil Controls, Buttress Construction, and Water Treatment

Alternative 2-2 would construct enhanced surface water diversions around the tailings and waste rock piles, construct a buttress that would be stable under selected seismic conditions, and regrade and vegetate the tailings and waste rock piles. The alternative would be designed to limit migration of contaminated surface water by collecting and treating adit and dam seepage, regrading and vegetating the tailings area to reduce infiltration, regrading and creating surface water diversions through other areas of waste rock to reduce infiltration and reduce the mine drainage from the adit. Treatment of mine drainage and tailings pile seepage would be included. This alternative would also include access and use restrictions to protect human receptors.

Access and Land Use Restrictions

Access restrictions would be implemented around the mine buildings and tailings and waste rock piles in the form of chain-link fences installed around the perimeter to reduce human exposure to and disturbance of contaminated soil, sediment, and waste rock.

Land use restrictions for parcel 39-160-25 would prohibit residential use, and intrusive activities such as construction or excavation of any type in the area adjacent to the mine buildings, the tailings and waste rock piles, the adit and associated water treatment pipelines and facilities, and the Little Clipper Creek stream channel and/or diversion structures (see discussion below under this alternative for further detail on these structures). These requirements would be memorialized in a deed restricton placed on this parcel. This alternative would include abandonment of the current residence located on parcel 39-160-25, which would be subject to the above specified use restrictions. This parcel may also be subject to re-zoning if deemed necessary.

Land use restrictions (which would take the form of a deed restriction) to be placed on parcel 39-160-28 would also prohibit residential, commercial, and recreational use, and intrusive activities such as construction or excavation of any type in the vicinity of the rock buttress and the Little Clipper Creek stream channel and/or diversion structures (see discussion below under this alternative for further detail on these structures). This parcel may also be subject to re-zoning if deemed necessary.

Land use restrictions may be necessary for the westernmost portion of parcel 39-160-27, which appears to be crossed by the existing Little Clipper Creek diversion channel (a site survey conducted during the design or contruction phase of the projects will verify the position of the channel with respect to this parcel). A deed restriction would specifically prohibit prevent physical disturbance or alteration of the diversion structure.

Land use restrictions may be necessary for parcel 39-160-29, which contains a gravel roadway which may have been constructed partially with waste rock and/or tailings, and which would be covered with an asphalt cap. In this case a deed restriction would be necessary to prevent disturbance of the asphalt cap.

Implementation of property use restrictions would be guided by CA/DTSC regulations pertaining to land use covenants (Section 67391.1, Title 22, Division 4.5, Chapter 39, California Code of Regulations).

Regrade and Vegetate Tailings Disposal Area and Adjacent Waste Rock Pile

Improved slopes and drainage swales would be provided to facilitate runoff and reduce surface water infiltration into the tailings and waste rock pile. Following grading, the area would be covered with soil to assist in revegetation. The area requiring grading is approximately 5.0 acres.

Arsenic has been detected at concentrations exceeding background levels in surface soil samples collected adjacent to waste areas, such as the tailings and waste rock pile. As part of Alternative 2-2, for cost estimation purposes it was assumed an area 50 feet wide surrounding the perimeter of the tailings and waste rock pile would be excavated to a depth of 1 foot and incorporated with the tailings and waste rock prior to regrading or revegetation.

Regrade Other Waste Rock Areas

Waste rock refers to the unprocessed rock removed from the mine during mining operations. The waste rock ranges in size from 8-inch-diameter pieces to sand-sized particles and primarily comprises rock in the 1- to 4-inch-diameter range. Although the waste rock contains arsenic, it does not have the high potential to erode or leach as the tailings do as the arsenic is mostly bound up in the rock matrix. Consequently, stockpiled waste rock outside of the tailings area would not be targeted by the same remedial actions proposed for the tailings.

In Alternative 2-2, the waste rock would be graded to facilitate runoff and reduce surface-water infiltration. The area requiring grading is approximately 5.6 acres. Also, to reduce dust emissions, the primary access roads on the mine property would be paved.

Construct Buttress

The existing, partially failed log dam will not prevent release of tailings for the desired design criteria (see Section 12). Because the dam is the predominant feature keeping the tailings onsite, an improved buttress, stable under selected seismic conditions, was included in this remedial alternative. The buttress would be constructed of waste rock obtained onsite following removal of tailings within, adjacent to, and immediately downstream of the footprint of the proposed buttress. Dewatering of a portion of the tailings would be required before buttress construction.

The buttress would be approximately 20 feet high with a downstream slope of 2.5:1 horizontal to vertical and placed directly on bedrock. To prevent seepage of contaminated groundwater through the buttress, a liner would be installed. A drain on the upstream face of the liner and connecting to an outlet pipe at the base of the buttress would collect and pass seepage water to the treatment plant to be constructed onsite.

To achieve and maintain a dewatered condition directly upstream of the buttress, horizontal drains would be placed and connected to the liner drain system on the upstream face of the buttress. For stability, the upstream tailings pile/waste rock materials would be graded and placed at a slope of 8:1 or flatter for a distance of at least 150 feet above the buttress.

Channelize Little Clipper Creek and Other Drainages

Existing stream diversion channels adjacent to the tailings and waste rock pile would be upgraded to prevent communication between the surface water flows and the tailings pile, thereby reducing infiltration and erosion of tailings. Additionally, surface-water diversion channels would be constructed to direct flow around the upper areas of stockpiled waste rock. The existing diversion for the mine adit drainage would be reconstructed to separate surface drainages above and adjacent to the existing adit pool from the contaminated adit discharge.

For remedial alternative development and costing, it was assumed that the channels would be constructed to control the 100-year storm return flow. Channels would be located just off the edge of the tailings and waste rock pile to the extent practical to facilitate design and construction. The channel for the western drainages would begin above the main Mine Area to divert the existing drainage running adjacent to the mine buildings. At the upgradient end, the channels would be excavated to key into the bedrock, allowing capture of subsurface flow through the uppermost alluvial layer. The channels would be lined to minimize seepage from the channel into the underlying tailings and provide added scour protection.

Adit and Buttress Seepage Collection

Mine drainage from the adit is contributing to high arsenic concentrations downstream. The entrance to the adit has collapsed and is no longer visible at the surface. Seepage from the adit continues to discharge to a small pond located near the former portal. Pumping water out of the mine workings is assumed in this alternative as a method of collecting mine water for treatment and minimizing or eliminating adit discharge. Pumping from the mine workings would also allow the workings to be used for storage when the treatment plant to be constructed under this alternative is temporarily out of operation.

A collection structure at the adit would also be constructed to collect any seepage that remains after the pumping from the mine shaft has lowered water levels below the adit and surface water diversions have minimized infiltration through the waste rock. The seepage from the tailings pile would also be collected at the buttress for treatment.

Treatment of Adit and Buttress Seepage

The flow estimates for both the adit and buttress seepages are currently based on limited data. In addition, potentially significant reductions in flow volumes could occur as part of implementation of the other components of this alternative. Thus, additional data need to be collected prior to design of the full-scale treatment system that will be in operation for the foreseeable future. Selection of the treatment process and its cost will depend on the actual flow rates to be treated and the projected arsenic concentrations of the adit and buttress seepage.

For remedial alternative development and costing, conceptual treatment system design and cost estimates were developed for both low and high flows. Ferric chloride coagulation followed by microfiltration has proven to be a reliable, cost-effective method of arsenic removal from water streams. Ferric chloride coagulation with microfiltration has therefore been selected as the representative process option for treatment of the adit and buttress seepages under both the low-flow and the high-flow scenario. In the event that remedial design investigations show that the total flow from the system is at the low end of the estimated range, pilot-level testing of adsorptive media treatment technologies or other innovative technologies may be conducted because of the potential lower capital costs and minimal operator requirements. The final treatment process will be determined during remedial design, after the rest of the remedy has been constructed and additional data collected.

The ferric chloride coagulation/filtration process would require construction of a treatment plant comprised of the following components: pH Adjustment, pre-oxidation, ferric chloride coagulation, microfiltration, thickening, sludge dewatering and disposal, and aeration. The treated water will be discharged to Little Clipper Creek.

Monitoring

It is assumed that Little Clipper Creek would be monitored to identify potential impacts to surface water flowing through and downstream of the Mine Area, particularly following storm events. Effluent from the treatment plant would also be monitored routinely. Groundwater monitoring wells would be installed and monitored downgradient of the tailings pile to ensure that the in-place tailings are not a long-term threat to groundwater quality.

9.2.3 Alternative 2-3 – Capping and Buttress Construction

Alternative 2-3 is similar to Alternative 2-2 with a few key modifications (described below) related to the mine buildings, capping of the tailings/waste rock pile, and covering the other waste rock areas. All other remedy components are the same as described above for Alternative 2-2.

Excavation and Hazard Abatement in and around Mine Buildings

Arsenic concentrations up to 31,200 ppm and cyanide concentrations up to 419 ppm were detected in surface soil samples within and around the cyanide and mill buildings. These areas contain the highest concentrations detected at the Site. Ponded water samples taken from sumps within the mill and cyanide buildings had concentrations of arsenic up to 14,300 ppb and cyanide up to 53 ppb. Hazard abatement activities would be focused on the areas of maximum contaminant concentrations within the mill and cyanide buildings. Excavated soils would be subjected to chemical analysis and consolidated onsite or disposed of offsite at an appropriate facility.

For purposes of alternative evaluation and cost estimating, it was assumed that hazard abatement activities would include the removal of soil and debris associated with former process tanks, removal of cyanide vats, and removal of sumps, including the removal and treatment of ponded water within the sumps. Following soil excavation and hazard abatement, the concrete foundations and metal siding of the buildings would be decontaminated.

Regrade and Cap Tailings/Waste Rock Pile

The tailings would be regraded and capped to minimize seepage into the tailings. For alternative development and cost estimating, it is assumed that the impermeable cap would consist of a synthetic liner and a low-permeability soil cover. Areas to receive the cap would be regraded to slopes of 4:1 or flatter. Following placement of the liner, a minimum of 18 inches of low-permeability cover soil would be placed and compacted. The cover would then be vegetated to reduce erosion potential.

As in Alternative 2-2, for alternative evaluation and cost estimation purposes it is assumed an area 50 feet wide surrounding the perimeter of the tailings and waste rock pile would be excavated to a depth of one foot and incorporated with the tailings and waste rock prior to capping.

Regrade, Cover and Vegetate Other Waste Rock Areas

As described for Alternative 2-2, the waste rock would be regraded to facilitate runoff and reduce surface-water infiltration. For Alternative 2-3, following grading, the area would be covered with one foot of soil and vegetated. The cover soil and vegetation would help to further reduce erosion and infiltration.

9.2.4 Alternative 2-4 – Capping, Stabilization and Buttress Construction

Alternative 2-4 is similar to Alternative 2-3 with a few minor modifications related to the mine buildings and stabilization of the tailings. Each of these is described in this section. All other remedy components are the same as described above for Alternative 2-3.

Excavation, Hazard Abatement, and Demolition of Mine Buildings

The soil excavation and hazard abatement would the same as Alternative 2-3. In addition, the mine buildings associated with historical ore-processing activities would be demolished, leaving the concrete foundations in place. The foundations and metal siding and roofing would be decontaminated. The metal would be disposed offsite and the wooden frames disposed onsite.

In-situ Stabilization of Tailings

The saturated tailings near the existing log dam or proposed buttress may be subject to liquefaction during a significant seismic event, resulting in potential lateral spreading and increased pressure on the buttress. These tailings would be stabilized by adding cement.

9.2.5 Alternative 2-5 – Excavation and Onsite Disposal

Alternative 2-5 shares many of the same components as Alternative 2-4. However, there is a major difference in the handling of the tailings/waste rock pile. All of the tailings would be excavated, dewatered and disposed in a new, lined onsite disposal cell. This eliminates the need for construction of the buttress and capping the tailings pile. This approach results in changes to many of the alternative components described above for Alternatives 2-2, 2-3, and 2-4.

Access and Land Use Restrictions

This component would be the same as previously described except as follows.

Parcel 39-160-27 would not be subject to land use restrictions as the Little Clipper Creek channel would be restored and therefore no diversion structure would be necessary.

Parcel 39-160-28 would not be subject to land use restrictions as removal of the tailings from the existing disposal area would make construction of a buttress unnecessary.

The portion of parcel 39-160-25 subject to land use restrictions would change. Restrictions would be necessary for the land surface which would be occupied by the newly-constructed disposal cell as opposed to the area where mine tailings are currently located. Land use restrictions in the form of deed restrictions and rezoning would prohibit residential, recreational, and groundwater use, and intrusive activities such as construction or excavation of any type in the area adjacent to the mine buildings, the adit and associated water treatment pipelines and facilities, and the newly constructed landfill cell. This alternative would still include abandonment of the current residence located on parcel 39-160-25.

Excavation, Hazard Abatement, and Demolition of Mine Buildings

This would be the same as Alternative 2-4 except that the concrete foundations and footings would likely need to be removed for placement of the onsite disposal cell. Plus, excavated soil and demolition debris would be consolidated with tailings in the existing disposal area for long term management.

Excavate Tailings

Only the tailings would be excavated, not the waste rock. The existing waste rock cover over the tailings pile would be removed and stockpiled. The underlying tailings would be excavated down to native soil. The volume of tailings is estimated as approximately 50,000 cy. In addition to the tailings, contaminated surface soil adjacent to the tailings and waste rock pile would be excavated. The additional volume of soil is estimated as 5,000 cy. The area outside the Little Clipper Creek channel would be backfilled with waste rock and regraded. Waste rock would be maintained outside of the 100-year flow of Little Clipper Creek.

The tailings would need to be dewatered and dried prior to placement in the onsite disposal cell. The water removed during dewatering will likely be high in arsenic and require treatment.

Dispose Tailings Onsite

An onsite disposal cell would be constructed to contain the excavated tailings as well as soil and debris from hazard abatement and demolition of the mine buildings. The volume of waste to be disposed of in the onsite disposal cell is estimated to be approximately 62,500 cy. For alternative development and costing, it is assumed that the design criteria for the onsite disposal cell would be based on requirements for California Title 27 Group A wastes.

The disposal cell location assumed for conceptual design of Alternative 2-5 covers the existing mill, assay, and cyanide buildings and makes use of an adjacent canyon. The ground would require considerable preparation work to create a more uniform slope and to create a trench for leachate collection before the bottom liner could be installed. For ease of implementation, a dual synthetic liner and composite liner (clay and synthetic) were assumed for alternative development. A blanket-type leachate collection and removal system would be installed, as would a leak detection monitoring system. The waste would be covered with a synthetic liner and a minimum of 18 inches of compacted, low-permeability cover soil. The disposal cell would be vegetated to reduce erosion potential. Piping would be placed to transport collected leachate from the onsite disposal cell to the mine area treatment plant.

Regrade, Cover and Vegetate Waste Rock Areas

This component would be the same as Alternative 2-3 except the area would be expanded to include the waste rock that had been adjacent to and covering the tailings.

Restore Little Clipper Creek and Channelize Other Drainages

The Little Clipper Creek channel would be restored to as natural condition as possible. Waste rock would be moved to outside of the projected 100-year flow area and riprap would be required to stabilize and shape the channel through the areas currently containing waste rock and tailings.

Diversion channels would be constructed to divert flow around the onsite disposal cell and the areas of stockpiled waste rock. The existing diversion for the mine adit drainage would be reconstructed to separate surface drainages above and adjacent to the adit pool from the contaminated adit discharge.

Monitoring

Monitoring requirements would be similar to those described for Alternative 2-2 except that additional groundwater and surface water monitoring around the disposal cell would be required.

9.2.6 Alternative 2-6 – Excavation and Offsite Disposal

Alternative 2-6 is identical to Alternative 2-5 except that the tailings would be transported to an offsite disposal facility rather than disposed of in an onsite disposal cell. Disposing the tailings offsite, rather than constructing an onsite disposal cell, results in minor modifications to some of the remedy components compared to Alternative 2-5. These are described below.

Access and Land Use Restrictions

This component would be the same as in Alternative 9.2.5 above except as follows.

The portion of parcel 39-160-25 subject to land use restrictions would further change. Deed restrictions would only be necessary to specify the placement and unobstructed operation of the treatment facilities and protection of the adit and associated water treatment pipelines and facilities from any interference or alteration. This alternative would still include abandonment of the current residence located on parcel 39-160-25.

Excavation, Hazard Abatement, and Demolition of Mine Buildings

This would be the same as Alternative 2-4 rather than Alternative 2-5.

Dispose Tailings Offsite

The tailings are not expected to be considered a state or Resource Conservation and Recovery Act (RCRA) hazardous waste and therefore would be disposed of in a RCRA Subtitle C facility. Offsite disposal would need to comply with the Superfund Offsite Rule (40 C.F.R. Section 300.440). The offsite trucking of the tailings would generate a high volume of truck traffic on several of the roads around the Site (using standard dump trucks with a capacity of five cubic yards each would require ten thousand truck loads to ship the waste offsite). Improvements would be required for the mine access roads prior to excavation and offsite disposal activities. Repairs, including repaving, would likely be required following remediation for Tensy Lane, Greenhorn Road, and Lava Cap Mine Road because of the high volume of truck traffic.

Restore Little Clipper Creek and Channelize Other Drainages

Same as Alternative 2-5 except diversion around an onsite cell is not required.

Monitoring

Monitoring requirements would be similar to those described for Alternative 2-5 except that none of the groundwater or surface water monitoring associated the disposal cell would be required.

9.3 Little Clipper Creek Alternatives

The portion of Little Clipper Creek included in the Mine Area OU and evaluated in the remedial alternatives extends from downstream of the log dam to Greenhorn Road. The primary area of deposition exists along the Little Clipper Creek corridor (on parcel numbers 39-170-66 and 39-170-77). Additional reaches of this section of Little Clipper Creek have small, isolated areas of tailings that would be incorporated into the remedial action to the extent practicable.

9.3.1 Alternative 3-1 – No Action

As described previously, the NCP requires USEPA to consider a no action alternative and to evaluate the risk to the public if no action were taken. The No-Action Alternative provides a baseline for comparison with other remedial alternatives under consideration. In this alternative, no remedial actions would be taken to address the contaminated sediment present in and adjacent to the Little Clipper Creek channel.

9.3.2 Alternative 3-2 – Institutional Controls Only

As a minimal action alternative, Alternative 3-2 would include access and use restrictions. To limit human exposure to contaminated soil, signs would be posted along the creek channel on parcels 39-170-66 and 39-170-77 indicating the presence of arsenic-contaminated sediment, and advising against recreational activity that would result in contact with the sediment. Land use restrictions in the form of deed restrictions would be developed to restrict recreational activities and to prevent intrusive activities such as construction or excavation in the areas of contamination. Periodic site inspections would be conducted to verify land use and maintenance of signage.

Implementation of property use restrictions would be guided by CA/DTSC regulations pertaining to land use covenants (Section 67391.1, Title 22, Division 4.5, Chapter 39, California Code of Regulations).

9.3.3 Alternative 3-3 – Capping and Channelization

Alternative 3-3 would intend to limit migration of contaminated sediment by channelizing Little Clipper Creek and limit human and ecological exposure to contaminated sediment by capping the contaminated sediment and implementing land use restrictions.

Land use restrictions in the form of deed restrictions would be implemented on parcels 39-170-66 and 39-170-77 to prevent intrusive activities, such as construction or excavation, that could compromise the soil cover.

For alternative development and cost estimation, it was assumed that sediment in the primary area of deposition would be covered with 2 feet of uncontaminated soil. The area would be vegetated to reduce erosion potential. The soil needed to construct the cover would be transported from an offsite borrow source and would be subjected to chemical analysis to ensure compliance with the cleanup goals cited in Section 8 above.

To limit potential erosion of the capped sediment, Little Clipper Creek would be channelized through the primary area of deposition upstream of Greenhorn Road. The channel would be sized to handle the flow from a 100-year storm event. The constructed channel would be lined with a synthetic liner and gabions.

Periodic monitoring and maintenance would be required indefinitely to verify that the cover is still in-place and performing as intended. In addition, surface water monitoring, as described for Alternative 3-2 would be included.

9.3.4 Alternative 3-4 – Excavation

Alternative 3-4 would be intended to protect human and ecological receptors by excavation of contaminated sediment along the Little Clipper Creek channel. For alternative development and cost estimation, it was assumed that the average depth of excavation in the primary area of deposition would be one foot. Actual depth of excavation would be determined by sampling during the design and/or construction phases of the project which would identify more precisely areas of sediment exceeding the cleanup levels established in Section 8 above. Additional sampling would be conducted after completion of the remedial action and this data set would be analyzed using statistical methods (specifically USEPA guidance document entitled Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites/EPA 540-R-01-003/September 2002) and compared to the cleanup goals to determine the success of the remedial actions taken.

Depending on the alternative chosen for the tailings in the mine area (described in Section 9.2), the excavated sediment would be: 1) consolidated with the tailings and waste rock pile for regrading or capping; 2) subjected to chemical analysis and disposed of in an appropriate offsite disposal facility; or 3) disposed in an onsite disposal cell.

Because this alternative would remove sediments exceeding the cleanup goals in Section 8, this alternative would <u>not</u> require implementation of institutional controls.

10 Comparative Analysis of Alternatives

The remedial alternatives described in Section 9 are evaluated using the nine Superfund evaluation criteria listed in 40 C.F.R. Section 300.430, which are described below. The comparative analysis provides the basis for determining which alternatives present the best balance of the criteria. The first two evaluation criteria are considered threshold criteria that the selected remedial action must meet. The five primary balancing criteria which are listed below employed in the process of comparing alternatives to achieve the best overall solution. The two modifying criteria, state and community acceptance, are also considered in remedy selection.

Threshold Criteria

- **Overall Protection of Human Health and the Environment** addresses whether an alternative provides adequate protection of human health and the environment, and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

- **Compliance with ARARs** addresses the requirement of Section 121(d) of CERCLA that remedial actions attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA Section 121(d)(4).

Primary Balancing Criteria

- **Long-term Effectiveness and Permanence** refers to the ability of a remedy to maintain reliable protection of human health and the environment over time.

- **Reduction of Toxicity, Mobility, or Volume Through Treatment** refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

- **Short-term Effectiveness** addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers and the community during construction and operation of the remedy until cleanup goals are achieved.

- **Implementability** addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, coordination with other governmental entities, as well as other factors, are also considered.

- **Cost** evaluates the estimated capital, O&M, and indirect costs of each alternative in comparison to other equally protective alternatives.

Modifying Criteria

- **State Acceptance** indicates whether the state agrees with, opposes, or has concerns about the preferred alternative.

- **Community Acceptance** includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose.

This section describes each threshold and primary balancing criterion, evaluates each alternative in relation to each criterion, and identifies advantages and disadvantages among the alternatives in relation to each criterion. Tables 10 (Mine Area Residences Alternatives), 11 (Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives), and 12 (Little Clipper Creek Alternatives) present comparative matrices in which the alternatives are ranked for each of the evaluation criterion. The details of how the rankings have been assigned for each criterion are provided below.

10.1 Overall Protection of Human Health and the Environment

The NCP requires that all alternatives be assessed to determine whether they can adequately protect human health and the environment from unacceptable risks from site contamination. These risks can be mitigated by eliminating, reducing, or controlling exposure to hazardous substances, pollutants, or contaminants.

10.1.1 Mine Area Residences Alternatives

Alternative 1-1, as the "no action" alternative, by definition, results in no change to the existing risks to human health and the environment which are described in Section 7, and achieves none of the Remedial Action Objectives.

Alternative 1-2 does not involve any physical measures to address Site related contaminants (and therfore would not meet the soil cleanup goal specified in Section 8) but relies on institutional means to prevent human contact with the mine tailings. Institutional controls are generally considered less reliable than physical measures because individuals unaware of use restrictions may still come in contact with Site related contaminants. Institutional measures are also not as effective as physical measures at reducing risks to the environment because ecological receptors lack the means of interpreting such measures as deed restrictions.

Alternatives 1-3 and 1-4 both employ physical means of preventing exposure of human and ecological receptors to Site related contaminants. Alternative 1-4 would permanently remove contaminanted soil from the areas surrounding the residences, thereby achieving the soil cleanup goal specified in Section 8, and completely eliminating this risk pathway. Alternative 1-3 achieves the soil cleanup goal by relying on implementation of a barrier or soil cover to reduce exposure, which would require institutional measures to ensure the barrier would not be disturbed by human activity thereby resulting in re-establishment of the risk pathway.

10.1.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives

Alternative 2-1, as the "no action" alternative, by definition, results in no change to the existing risks to human health and the environment which are described in Section 7, and achieves none of the Remedial Action Objectives.

In terms of risks related to contaminated surface water, Alternatives 2-2 through 2-6 involve the same water treatment components (collection of water emanating from the mine adit and from the tailings pile and treatment using coagulation/filtration or an equivalent processes) and would therefore all meet the

TABLE 10
Mine Area Residences Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 1-1: No Action	None	C – RAOs would not be achieved. Risks to health of residents in the mine area would be above acceptable range.	No grade assigned because there are no chemical-, action-, or location-specific ARARs applicable.	C –Future risks to human health would not be diminished.	C – No treatment or reduction in TMV of soil contamination.	C – No remedial action; therefore, no additional impacts to populations from implementation. RAOs would not be achieved.	A – Implementable.	0
Alternative 1-2: Institutional Controls	Access and Land Use Restrictions	B – Controls human exposure to site contamination through access and use restrictions, as long as they are actively enforced.	A – Complies with DTSC's Land Use Covenants Regulations governing implementation of institutional controls.	B – Residual risk of arsenic contamination would not be eliminated; however, risk would be controlled using access and land use restrictions. Institutional controls would require long-term enforcement and agency coordination to be effective.	C – No treatment or reduction in TMV of soil contamination.	A – No construction activities; therefore, no additional impacts to populations from implementation. RAO of protection of human exposure to contaminated soil would be achieved rapidly, as long as institutional controls are actively enforced.	B – Implementation of institutional controls would require coordination with state and local governments and the property owner(s).	46,000
Alternative 1-3: Capping	Soil Cover Land Use Restrictions	B – Limits exposure of residents and ecological receptors to site contamination by covering contaminated soil adjacent to residences and implementing land use controls.	A – Complies with DTSC's Land Use Covenants Regulations governing implementation of institutional controls.	B – Residual risk of arsenic contamination would not be eliminated. However, risk to human health would be controlled, provided the soil cover is maintained and land use restrictions are enforced.	B – Capping reduces the mobility of the contaminated soil.	B – Risk to the community, onsite workers, and the environment from dust, noise, and truck traffic would be minimized by appropriate controls and protective measures. RAOs would be achieved rapidly.	B – Implementable; soil cover technology is considered reliable; equipment and technology are available. Implementation of institutional controls would require coordination with state and local governments and the property owner(s).	250,000

TABLE 10
Mine Area Residences Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 1-4: Excavation	Excavation	A – Provides protection of human health by removing contaminated soil surrounding the residences and backfilling with uncontaminated soil.	A – Complies with ARARs. Excavation and disposal would comply with chemical-, and action-specific ARARs. No location-specific ARARs have been identified as applicable.	A – Excavation and disposal would provide effective and permanent reduction of risk to mine area residents. Long-term management and monitoring would be required for onsite disposal or consolidation with tailings.	A – TMV of arsenic-contaminated soil adjacent to residences would be reduced through excavation and offsite disposal, onsite disposal, or consolidation with tailings for capping.	B – Risk to the community, onsite workers, and the environment from dust, noise, and truck traffic would be minimized by appropriate controls and protective measures. RAOs would be achieved rapidly.	A – Implementable; excavation technology is considered reliable; equipment and technology are available.	<u>1-4A (Consolidate)</u> 310,000 <u>1-4B (Offsite)</u> Class II facility 500,000 Addit. Contingency cost if dispose in Class I facility 430,000 <u>1-4C (Onsite)</u> 350,000

Notes:

Qualitative assessment of the results of criteria evaluation:

A – Favorable

B – Favorable with qualifiers

C – Not favorable

TABLE 11
Mine Buildings, Tailings, Waste Rock and Mine Drainage Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 2-1: No Action	None	C – RAOs would not be achieved. Risks to health of future workers and mine area residents would be above acceptable range. Risks to ecological receptors would not be diminished. Does not reduce potential for release or migration of tailings during seismic or storm events. Contaminated mine area seeps would continue to impact surface water quality in LCC.	C – Continued discharge of mine area seeps would not comply with chemical-specific ARARs. Existing tailings impoundment would not comply with the siting and construction standards for existing mine units.	C – Residual risk to human health and the environment would not be diminished.	C – No treatment or reduction in TMV.	C – No remedial action; therefore, no additional impacts to populations from implementation. RAOs would not be achieved.	A – Implementable.	0

TABLE 11
Mine Buildings, Tailings, Waste Rock and Mine Drainage Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 2-2: Surface Soil Controls and Buttress Construction	Surface Soil Controls for Tailings and Waste Rock Buttress Construction Channelize LCC and Western Drainages Ex situ Chemical Treatment of Adit and Buttress Seepages Access and Land Use Restrictions	B – Controls human exposure to contaminated soil and surface water through access and use restrictions, as long as they are actively enforced. Does not provide protection for ecological receptors to contaminated soil. Reduces potential for release or migration of tailings through buttress construction, stream channel modifications, and surface soil controls. Reduces TMV of contaminated surface water by eliminating or treating mine area seeps.	A – Complies with ARARs. Treatment of mine area seeps would comply with chemical- and action-specific ARARs. Existing tailings impoundment would comply with the siting and construction standards for existing mine units. Complies with DTSC's Land Use Covenants Regulations governing implementation of institutional controls. No location-specific ARARs are thought to be applicable.	C – Residual risk of arsenic contamination would not be eliminated in soil or sediment. However, risks to human health and the environment would be controlled, provided access and use restrictions, surface soil controls, and channel diversions are maintained. C/MF would provide effective and permanent reduction of TMV of contaminated surface water, but would require long-term O&M.	A – Reduction in TMV of arsenic contamination in surface water. Reduction in mobility of tailings and contaminated soil and sediment.	A – Risk to the community, onsite workers, and the environment from dust, noise, and truck traffic would be minimized by appropriate controls and protective measures. Approximately 550 truck loads required for materials. RAOs for contaminated tailings, soil and sediment would be achieved rapidly. C/MF treatment system construction would likely occur after surface soil controls and buttress construction. RAOs for remediation and control of contaminated surface water would be achieved once treatment system operational.	A – Implementable. Implementation of institutional controls would require coordination with state and local governments and the property owner(s). Construction activities would use readily available conventional construction equipment. C/MF treatment systems have been designed and operated at full-scale, and equipment is readily available from commercial vendors. Additional data on the flow rates of the adit and buttress would need to be collected prior to design.	<u>NPV without treatment</u> 3,400,000 <u>Low-flow treatment (2-2A)</u> 3,300,000 <u>High-flow treatment (2-2B)</u> 7,900,000

TABLE 11
Mine Buildings, Tailings, Waste Rock and Mine Drainage Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 2-3: Capping and Buttress Construction	Components of Alternative 2-2, and Cap Tailings Area Excavation and Hazard Abatement in and around Mine Buildings Regrade, Cover, and Vegetate Other Areas of Waste Rock	A – Additional controls in Alternative 2-3 would provide greater protection of humans and ecological receptors by capping tailings, abating hazards and excavating areas of greatest contamination in and around mine buildings, and covering and vegetating waste rock. Impermeable cap further limits the infiltration of surface water and production of contaminated seepage from the buttress.	A – Complies with ARARs. Treatment of mine area seeps would comply with chemical- and action-specific ARARs. Excavation and disposal would comply with chemical-specific and action-specific ARARs. No location-specific ARARs are thought to be applicable.	B –Additional controls in Alternative 2-3 would provide greater long-term effectiveness than Alternative 2-2. Placement of an impermeable cap over tailings would more effectively reduce surface water infiltration. Placement of cover soil and revegetating other areas of waste rock would more effectively discourage removal or disturbance of waste rock. Hazard abatement and excavation in the mine buildings would remove hazards posed by some of the greatest contaminant concentrations onsite.	A – Reduction in TMV of arsenic contamination in surface water. Reduction in mobility of tailings and contaminated soil and sediment. Impermeable cap further limits volume of contaminated seepage from the buttress.	A – Same as Alternative 2-2, with controls and protective measures also required during excavation and disposal of highly contaminated material around mine buildings. Approximately 1,700 truck loads required for materials.	A – Implementable. Same as Alternative 2-2.	<u>NPV without treatment</u> 5,400,000 <u>Low-flow treatment (2-3A)</u> 3,300,000 <u>High-flow treatment (2-3B)</u> 7,900,000

TABLE 11
Mine Buildings, Tailings, Waste Rock and Mine Drainage Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 2-4: Capping, Stabilization, and Buttress Construction	Components of Alternative 2-3, and In situ Stabilization of Tailings Demolition of Mine Buildings	A - Cement stabilization of portion of tailings would increase the stability of tailings during seismic events and decrease the potential for contaminant leaching. Demolition of mine buildings removes physical hazards from deteriorating structures.	A – Demolition of mine buildings requires consideration of the NHPA.	B - Same as Alternative 2-3. Cement stabilization would be expected to permanently and effectively increase the shear strength and potentially decrease leaching potential of contaminants.	A – Same as Alternative 2-3. Addition of cement to tailings decreases the leachability of contaminants, but increases the volume of contaminated material.	A – Same as Alternative 2-3.	A - Additives for tailings stabilization are readily available and inexpensive. Distributing cement and achieving uniform mixing in situ may be difficult. Demolition of mine buildings requires consideration of the NHPA.	<u>NPV without treatment</u> 6,300,000 <u>Low-flow treatment (2-4A)</u> 3,300,000 <u>High-flow treatment (2-4B)</u> 7,900,000

TABLE 11
Mine Buildings, Tailings, Waste Rock and Mine Drainage Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 2-5: Excavation and Onsite Disposal	Excavate Tailings Dispose of Tailings in Onsite Disposal Cell Excavation, Hazard Abatement, and Demolition of Mine Buildings Regrade, Cover, and Vegetate Waste Rock Restore LCC Channel Channelize Western Drainages Ex situ Chemical Treatment of Adit Seepage Access and Land Use Restrictions	A – Tailings removal provides protection of mine area residents, future workers, and ecological receptors and eliminates the potential for migration or release of contaminated tailings. Onsite disposal cell would be maintained and monitored to minimize the potential for contaminant releases to groundwater.	A - The onsite disposal cell would be constructed and maintained in compliance with action- and location-specific ARARs. Excavation and handling of wastes would comply with chemical-, and action-specific ARARs. Demolition of mine buildings requires consideration of the NHPA.	B – Excavation and disposal in an engineered onsite disposal cell would provide effective and permanent reduction of risk to human health and the environment. Removal of tailings reduces volume of contaminated surface water seeps, and reduces O&M costs for treatment of mine seeps. Onsite disposal includes potential residual risks of contaminant releases to groundwater and requires prompt cover maintenance, leachate collection and recovery, leak detection, and groundwater monitoring.	A – Mobility of arsenic-contaminated tailings would be reduced through excavation and onsite disposal. Because tailings remain onsite for disposal, toxicity and volume would not be reduced. Design of onsite disposal cell would comply with Group A waste criteria to minimize potential for contaminant releases to groundwater.	B – Requires significant handling of contaminated material during excavation, dewatering and disposal of tailings. Approximately 2,000 truck loads required for materials. Impacts from dust, noise, sediment migration, and truck traffic would be minimized during construction activities using appropriate controls and protective measures. Water removed during dewatering of tailings would require storage or immediate treatment. RAOs for contaminated tailings, soil and sediment would be achieved rapidly. RAOs for surface water would be achieved once treatment system operational.	B – Requires significant handling of contaminated material. Technical challenges associated with dewatering of the excavated tailings to an optimum moisture content and construction of an onsite disposal facility on steep topography in a remote location. Onsite disposal facility would require future access and land use restrictions. Construction of the onsite disposal cell and implementation and enforcement of institutional controls would require coordination with state and local agencies and the land owner(s).	<u>NPV without treatment</u> 8,400,000 <u>Low-flow treatment (2-5A)</u> 3,300,000 <u>High-flow treatment (2-5B)</u> 5,900,000

TABLE 11
Mine Buildings, Tailings, Waste Rock and Mine Drainage Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 2-6: Excavation and Offsite Disposal	Same components of Alternative 2-5 with Offsite Disposal of Excavated Tailings	A – Tailings removal provides protection of mine area residents, future workers, and ecological receptors and eliminates the potential for migration or release of contaminated tailings.	A - Excavation and disposal would comply with chemical-specific and action-specific ARARs.	A - Excavation and disposal would provide effective and permanent reduction of risk to human health and the environment. Removal of tailings reduces volume of contaminated surface water seeps, and reduces O&M costs for treatment of mine seeps. Offsite disposal does not pose long-term risks to groundwater resources posed by onsite disposal. Offsite disposal facility assumes all long-term maintenance and monitoring associated with the disposal action.	A – TMV of arsenic-contaminated tailings would be reduced through excavation and offsite disposal.	B – Same as alternative 2-5. Requires greatest volume of truck traffic, approximately 4,100 truck loads for materials and offsite disposal of tailings. Risks to community from transportation of contaminated waste would be mitigated through spill prevention measures.	C – Requires significant handling of contaminated material. Technical challenges associated with dewatering of the excavated tailings to an acceptable moisture content. Potential administrative difficulties in identifying an offsite disposal facility that would accept the large volume of contaminated material. Requires coordination with broader community regarding offsite transport of contaminated material. Allows virtually unrestricted use of the site, with restrictions that waste rock remaining onsite would not be disturbed or removed.	<u>NPV without treatment</u> Disposal in Class II facility 11,000,000 Additional contingency cost if disposal in Class I facility 8,900,000 <u>Low-flow treatment (2-6A)</u> 3,300,000 <u>High-flow treatment (2-6B)</u> 5,900,000

Notes:

Qualitative assessment of the results of criteria evaluation:

A – Favorable

B – Favorable with qualifiers

C – Not favorable

Comparative analysis for the M/T/WR alternatives focuses on differences among alternatives rather than evaluation of each alternative component.
NPV – Net present value

The total net present value of the alternative is the sum of the NPV without treatment plus the NPV for either the low-flow or high-flow treatment scenario.

TABLE 12
Little Clipper Creek Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 3-1: No Action	None	C – RAOs would not be achieved. Health risks to residents and recreational users along LCC would be above acceptable range. Risks to ecological acceptors would not be diminished. Does not reduce potential for migration of tailings-impacted sediment.	C – Would not comply with ARARs requiring protection of the beneficial uses of surface water.	C – Future risks to human health and the environment would not be diminished.	C – No treatment or reduction in TMV of sediment contamination.	C – No remedial action; therefore, no additional impacts to populations from implementation. RAOs would not be achieved.	A – Implementable.	0
Alternative 3-2: Institutional Controls	Access and Land Use Restrictions Surface-water Monitoring	B – Reduces human exposure to contaminated sediment and surface water through access and use restrictions, provided restrictions are actively enforced. Does not reduce risks to ecological receptors. Potential impacts to surface water from tailings-impacted sediment would not be mitigated but would be monitored.	C – Would not comply with ARARs requiring protection of the beneficial uses of surface water. Complies with DTSC's Land Use Covenants Regulations governing implementation of institutional controls.	B – Residual risk to human health would not be eliminated; however, risk would be controlled using access and land use restrictions. Institutional controls would require long-term enforcement and coordination with agencies and property owners to be effective. Risks to ecological receptors and the environment would not be diminished.	C – No treatment or reduction in TMV of sediment contamination.	B – No construction activities; therefore, no additional impacts to populations from implementation. RAO of protection of human exposure to contaminated sediment would be achieved rapidly, assuming the industrial controls are actively enforced. RAOs for protection of ecological receptors and minimizing the potential for migration of contaminated sediment would not be achieved.	B – Implementation of institutional controls would require coordination with state and local governments and the property owners. Implementation and enforcement of institutional controls would be difficult; multiple parcels of property include portions of LCC upstream of Greenhorn Road and access to LCC is readily available from Greenhorn Road and Tensy Lane.	290,000

TABLE 12
Little Clipper Creek Comparative Analysis Matrix
Lava Cap Mine Site – Mine Area OU ROD

		Threshold Criteria		Balancing Criteria				
Remedial Alternative	**Major Components**	**Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementability**	**Estimated Net Present Value ($)**
Alternative 3-3: Capping and Channelization	Land Use Restrictions Channelize LCC Soil Cover and Revegetation Surface-water Monitoring	B – Reduces risks to residents and recreational users along LCC and ecological receptors by covering contaminated soil. Minimizes the migration of tailings-impacted sediment by channeling LCC through the primary area of deposition.	A – Complies with ARARs. Construction of an engineered channel and placement of a soil cover would comply with action- and location-specific ARARs.	B – Residual risk of arsenic contamination would not be eliminated. However, risk to human health and the environment would be controlled, provided the soil cover and channel are maintained.	B – No treatment or reduction in toxicity of arsenic contamination. Would limit the mobility of contaminated sediment and minimize future impacts of contaminated sediment on surface water.	B – Construction activities would impact the riparian habitat. Existing and native vegetation would be restored outside of the creek channel following construction activities. Impacts from dust, noise, sediment migration, and truck traffic would be minimized during construction activities using appropriate controls and protective measures. RAOs would be achieved within one construction season.	B – Soil cover and channel construction is a reliable technology and equipment is readily available. Construction activities and institutional controls would require coordination with multiple land owners. Would require excavation of large volume of sediment for construction of channel for 100-year flow. Access road would need to be constructed north of Tensy Lane.	1,000,000
Alternative 3-4: Excavation	Excavation Surface-water Monitoring	A – Removal of contaminated sediment in the primary area of deposition minimizes the potential for migration of contaminated sediment and reduces risks to residents, recreational users, and ecological receptors.	A – Complies with ARARs. Excavation and disposal would comply with chemical-, action-, and location-specific ARARs.	A – Excavation and disposal would provide effective and permanent reduction of risk to human health and the environment. Long-term management and monitoring would be required for onsite disposal or consolidation with tailings.	A – TMV of arsenic-contaminated sediment in LCC channel would be reduced through excavation and offsite disposal, onsite disposal, or consolidation with tailings for capping.	B – Construction activities would impact the riparian habitat. Following construction activities, the stream channel would be restored and the area revegetated with existing and native vegetation. Impacts from dust, noise, sediment migration, and truck traffic would be minimized during construction activities using appropriate controls and protective measures. RAOs would be achieved within one construction season.	A – Implementable. Excavation is a reliable technology and equipment is readily available. Would require coordination with multiple land owners. Access road would need to be constructed north of Tensy Lane. Excavation and disposal would allow unrestricted use of LCC.	3-4A (Consolidate with Tailings) 500,000 3-4B (Offsite) Class II facility 630,000 Additional contingency cost if dispose in Class I facility 320,000 3-4C (Onsite) 530,000

Notes:
Qualitative assessment of the results of criteria evaluation:
A – Favorable
B – Favorable with qualifiers
C – Not favorable

surface water cleanup goals specified in Section 8 (which are selected to be protective of human health and the environment).

In terms of risks related to contaminated soil, Alternatives 2-2 through 2-6 all eliminate the risk pathway (with varying degrees of permanence) and meet the Remedial Action Objectives. Alternative 2-2 utilizes the least physical means of control, namely regrading and placing a vegetative cover over the tailings, which would minimize airborne transport, reduce erosion, and provide a one foot thick barrier to contact by human and ecological receptors; it would rely upon land use restrictions to prevent penetration of the soil cover. Alternatives 2-3 and 2-4 would involve upgrades to the cover system, which would include a high density polyethylene layer overlain by eighteen inches of soil cover; they would also rely on land use restrictions to prevent penetration of the cover system. Alternative 2-5 would involve physically relocating the tailings to a new landfill cell to be constructed onsite; it would rely on insitutional controls to prevent the breaching of the landfill cell. Alternative 2-6 would involve physically relocating the tailings offsite; land use controls would be minimized in comparison to the other alternatives.

In terms of groundwater protectiveness the alternatives compare as follows (although USEPA is currently conducting a separate groundwater investigation, the protection of the beneficial uses of groundwater is included as one of the Remedial Action Objectives under this ROD). Alternative 2-2 is not intended to reduce permeability and therefore would allow precipitation and overland water flow to enter the tailings and continue to produce leachate. Alternative 2-3 and 2-4 utilize the same cover system, which includes a low permeability liner, which is designed to minimize infiltration of precipitation and overland water flow into the tailings; they would also re-route exisiting clean surface water flows which currently enter the tailings and result in the generation of leachate. Alternative 2-5 would incorporate into the design of the new landfill cell both a low permeability upper liner which would minimize infiltration from precipitation and overland water flow, and a low permeability lower liner which would minimize the infiltration of leachate from the landfill cell into the underlying soil. Alternative 2-6 would involve physically relocating the tailings offsite and therefore the tailings would no longer generate leachate onsite.

10.1.3 Little Clipper Creek Alternatives

Alternative 3-1, as the "no action" alternative, by definition, results in no change to the existing risks to human health and the environment which are described in Section 7, and achieves none of the Remedial Action Objectives.

Alternative 3-2 does not involve any physical measures to address Site related contaminants (and therefore would not meet the sediment cleanup goal specified in Section 8) but relies on institutional means to prevent human contact with the mine tailings. Institutional controls are generally considered less reliable than physical measures because individuals unaware of use restrictions may still come in contact with Site related contaminants. Institutional measures are also not as effective as physical measures at reducing risks to the environment because ecological receptors lack the means of interpreting such measures as deed restrictions.

Alternatives 3-3 and 3-4 both employ physical means of preventing exposure of human and ecological receptors to Site related contaminants. Alternative 3-4 would permanently remove contaminanted sediment from the Little Clipper Creek stream channel, thereby achieving the sediment cleanup goal specified in Section 8, and completely eliminating this risk pathway. Alternative 3-3 achieves the sediment cleanup goal by relying on implementation of a barrier or soil cover to reduce exposure, which would require institutional measures to ensure the barrier would not be disturbed by human activity thereby resulting in re-establishment of the risk pathway.

10.2 Compliance with ARARs

This evaluation criterion is also a threshold requirement and is used to determine if each alternative would attain federal and state ARARs, or whether there is adequate justification for invoking waivers for specific ARARs.

10.2.1 Mine Area Residences Alternatives

No ARARs are applicable to Alternative 1-1. Alternatives 1-2 and 1-3 would comply with DTSC's Land Use Covenants Regulations. Alternative 1-4 would comply with chemical- and action-specific ARARs during classification, storage, transport, and disposal of excavated soil.

10.2.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives

Alternative 2-1 would not comply with ARARs. Specifically, continued discharge of mine area seeps under Alternative 2-1 would not comply with chemical-specific ARARs. All remaining alternatives would comply with ARARs. Treatment of mine area seeps in Alternatives 2-2 through 2-6 would comply with chemical-specific ARARs, including treatment of arsenic to the cleanup goal of 10 μg/L. Capping of tailings in Alternatives 2-2 and 2-3 would comply with appropriate action-specific ARARs. Excavation and disposal of contaminated material in Alternatives 2-3 through 2-6 would comply with chemical- and action-specific ARARs. Design, construction, maintenance, and monitoring of the onsite disposal cell in Alternative 2-5 would comply with action- and location-specific ARARs for Group A waste.

10.2.3 Little Clipper Creek Alternatives

Because of the potential for continued migration of tailings-impacted sediment along the Little Clipper Creek channel, Alternatives 3-1 and 3-2 would not comply with ARARs requiring protection of the beneficial uses of surface water. Capping of sediment and soil in Alternative 3-3 would comply with appropriate action-specific ARARs. Alternatives 3-3 and 3-4 would comply with action- and location-specific ARARs during construction activities. Alternative 3-4 would comply with chemical- and action-specific ARARs during classification, storage, transport, and disposal of excavated sediment.

10.3 Long-Term Effectiveness

This evaluation criterion assesses the extent to which each remedial alternative reduces risk and meets RAOs in the long term. Residual risk can result from exposure to untreated waste or treatment residuals. The magnitude of the risk depends on the magnitude of the wastes and the adequacy and reliability of controls, if any, that are used to manage untreated waste and treatment residuals.

10.3.1 Mine Area Residences Alternatives

Alternative 1-4 would provide permanent and long-term effectiveness in protecting human health because contaminants in surface soil surrounding the residences would be physically removed. Residual risks would remain in Alternatives 1-2 and 1-3; however, residual risks would be controlled, provided institutional controls are enforced over the long term. Alternatives 1-2 and 1-3 are rated lower in effectiveness because of their reliance on institutional controls. Institutional controls are generally considered less reliable than physical measures because individuals unaware of use restrictions may still come in contact with Site related contaminants. The enforcement of institutional controls would likely be the responsibility of state and local governments. All current and future risks would remain under Alternative 1-1.

10.3.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives

Alternative 2-6 would provide the most effective and permanent reduction of risk to human health and the environment from contaminated tailings through excavation and offsite disposal of tailings. Alternative 2-5 also provides effective and permanent reduction of risk through removal of tailings and placement in an engineered onsite disposal cell. The disposal cell would use an impermeable cover, precipitation and drainage controls, an impermeable liner, and leachate collection and treatment to prevent contaminant releases to groundwater or surface water. Based on the performance of existing landfill liners, it is estimated that little to no deterioration of synthetic materials would occur over a period in excess of 200 years. However, unlike offsite disposal, onsite disposal includes potential residual onsite risks and requires long-term cover maintenance, leachate collection and recovery, leak detection, and groundwater monitoring.

Under Alternatives 2-2, 2-3, and 2-4, the residual risk of arsenic contamination would remain in soil and sediment; however, risks to human health and the environment would be controlled with buttress construction, surface soil controls, capping, and/or tailings stabilization. Controls would require long-term maintenance and land use restrictions. Of these three alternatives, Alternatives 2-3 and 2-4 would provide the most effective long-term reduction of risk from contaminated tailings. Alternatives 2-3 and 2-4 also provide greater long-term reduction of risk than Alternative 2-2 by placing an impermeable cap over the tailings to more effectively reduce surface-water infiltration, placing cover soil and revegetating other areas of waste rock to more effectively discourage removal or disturbance of waste rock, and abating and/or excavating hazards in the mine buildings posed by some of the highest contaminant concentrations onsite.

Alternatives 2-2 through 2-6 include treatment of mine area seepages, which would provide reliable long-term reduction in surface-water contamination with only a small volume of treatment residuals. However, treatment of mine area seepages would require long-term O&M. Alternatives 2-5 and 2-6 allow for the smallest O&M costs by eliminating the tailings seeps. All current and future risks would remain under Alternative 2-1.

10.3.3 Little Clipper Creek Alternatives

Alternative 3-4 would provide permanent and long-term effectiveness in protecting human health and the environment because contaminated soil and sediment in the area of deposition would be physically removed. Residual risks would remain in Alternative 3-3; however, residual risks to human health and the environment would be controlled, provided the soil cover and channel are maintained. Small, isolated areas of tailings may remain in inaccessible portions of Little Clipper Creek north of Greenhorn Road outside of the primary area of deposition that is subject to remedial actions. Surface-water monitoring is proposed in Alternatives 3-3 and 3-4 to monitor potential impacts to surface-water quality from residual sediment.

Alternative 3-2 would attempt to manage long-term risks to human health through access and use restrictions; however, risks to ecological receptors and the potential for migration of contaminated sediment would not be diminished. Institutional controls would require long-term enforcement and coordination with agencies and property owners to be effective. All current and future risks to human health and the environment would remain under Alternative 3-1.

10.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

This criterion addresses the preference, as stated in the NCP, for selecting remedial actions employing treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as a principal element of the action. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

This evaluation focuses on the following factors for each remedial alternative:

- Whether the alternative satisfies the statutory preference for treatment as a principal element;
- The treatment process employed, including the amount of hazardous materials that will be destroyed or treated and the degree of expected reduction in toxicity, mobility, or volume;
- The degree to which treatment is irreversible; and
- The type and quantity of treatment residuals that will remain following treatment.

10.4.1 Mine Area Residences Alternatives

Alternative 1-4 would permanently reduce the toxicity, mobility, and volume of contaminated surface soil surrounding residences by excavation and disposal. Alternative 1-3 would reduce the mobility of contaminated soil by capping the area around the residence. Alternatives 1-1 and 1-2 would not result in treatment or reduction in toxicity, mobility, or volume of arsenic contamination.

10.4.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives

Alternative 2-1 would not result in treatment or reduction in toxicity, mobility, or volume of arsenic contamination. Remedial actions included in Alternatives 2-2 through 2-6 reduce the toxicity, mobility, and/or volume of surface-water contamination. Collection and treatment of mine area seeps is included in all alternatives involving active remediation (Alternatives 2-2 through 2-6).

Alternative 2-6 provides the greatest reduction in toxicity, mobility, and volume of contaminated tailings through physical removal of tailings and placement in an offsite engineered disposal facility. Alternative 2-5 also reduces the mobility of contaminated tailings through excavation, but the toxicity and volume of tailings contamination onsite is not reduced because tailings remain onsite. Alternatives 2-2, 2-3, and 2-4 include buttress construction, surface soil controls, capping, and/or tailings stabilization, all of which limit the mobility of contamination by limiting the potential for migration or release of contaminated tailings, soil, or sediment.

10.4.3 Little Clipper Creek Alternatives

Alternative 3-4 would permanently reduce the toxicity, mobility, and volume of contaminated soil and sediment along the Little Clipper Creek channel by excavation and disposal. Alternative 3-3 would not reduce the toxicity or volume of arsenic-contaminated sediment, but would limit the mobility of contaminated sediment and minimize future impacts of contaminated sediment on surface water. Alternatives 3-1 and 3-2 would not result in treatment or reduction in toxicity, mobility, or volume of arsenic-contaminated sediment.

10.5 Short-Term Effectiveness

This criterion evaluates the effects of each remedial alternative on human health and the environment during the construction and implementation phase until remedial action objectives are met. The following factors are addressed for each alternative:

- **Protection of workers and the community during construction and implementation phases.** This factor qualitatively examines risk that results from implementation of the proposed remedial action and the effectiveness and reliability of protective measures.

- **Environmental impacts.** This factor addresses the potential adverse environmental impacts that may result from the construction and implementation of an alternative. This factor also evaluates the reliability of the available mitigation measures to prevent or reduce potential impacts.

- **Time until RAOs are achieved.** This factor considers the amount of time required to construct remediation facilities and meet the remedial action objectives.

10.5.1 Mine Area Residences Alternatives

Remedial actions in Alternatives 1-3 and 1-4 would create short-term impacts (generation of dust, noise, and truck traffic) that would require readily available controls. There would be no short-term impacts for Alternatives 1-1 and 1-2. RAOs for protection of human exposure to contaminated soil would be achieved relatively rapidly under Alternatives 1-3 and 1-4. Human exposure RAOs may be achieved under Alternative 1-2 if institutional controls are actively enforced. RAOs would not be achieved for Alternative 1-1.

10.5.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives

There would be no short-term impacts for Alternative 2-1. One estimate of short-term impacts for alternatives is the estimated number of truckloads required to provide materials or to haul material offsite during implementation of the alternative. Alternative 2-2 would require the least amount of truck traffic (approximated as 550 truckloads). Alternatives 2-3 and 2-4 would require approximately 1,700 truckloads of material to implement, and Alternative 2-5 would require approximately 2,000 truckloads of material. Alternative 2-6 would result in the greatest amount of truck traffic, with an estimated 4,100 truckloads for offsite disposal of excavated tailings and provision of materials.

Alternatives 2-5 and 2-6 require significant handling of contaminated material during excavation, dewatering, and disposal of tailings that could present additional short-term impacts to the community, workers, and the environment during the remedial action. Additional risks to the broader community could occur under Alternative 2-6, which includes transportation of large volumes of contaminated material offsite.

For Alternatives 2-2 through 2-6, RAOs for the protection of human health and the environment would be achieved relatively rapidly. RAOs for contaminated tailings, soil, and sediment would be achieved within one construction season. Collection of mine area seepages and operation of the treatment system would achieve RAOs for surface water that is above cleanup goals, and would achieve protection of human and ecological receptors to contaminants in surface water that pose a significant risk. Determination of the treatment process and detailed treatment design would be dependent on the actual flow rates and arsenic concentrations of the mine area seepages, following implementation of remedial actions. As a result, construction of the treatment plant in Alternatives 2-2 through 2-6 would likely occur after implementation of remedial actions for contaminated tailings, soil, and waste rock and a pilot-scale treatment study. RAOs would not be achieved for Alternative 2-1.

10.5.3 Little Clipper Creek Alternatives

There would be no short-term impacts for Alternatives 3-1 and 3-2. Construction activities associated with Alternatives 3-3 and 3-4 would impact the riparian habitat associated with Little Clipper Creek. Following construction activities, the area impacted by construction activities would be graded and vegetated. Under Alternative 3-3, the engineered channel would not allow benthic communities to become re-established following construction activities. Short-term impacts from dust, noise, sediment migration, and truck traffic under Alternatives 3-3 and 3-4 would be minimized using appropriate controls and protective measures.

For Alternatives 3-3 and 3-4, RAOs for the protection of human health and the environment would be achieved within one construction season. For Alternative 3-2, RAOs for the protection of human health would be at least partially achieved with implementation of institutional controls. Alternative 3-2 would not achieve RAOs for protection of ecological receptors and minimizing migration of contaminated sediment. No RAOs would be achieved for Alternative 3-1.

10.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The following factors are considered:

Technical Feasibility

- Ability to construct and operate: addresses any technical difficulties and unknowns associated with construction or operation of the technology;
- Reliability of technology: focuses on the likelihood that technical problems associated with implementation will lead to schedule delays; and
- Ease of undertaking additional remedial action: includes a discussion of what, if any, future remedial actions may need to be undertaken and how the remedial action would interfere with, or facilitate, the implementation of future actions.

Administrative Feasibility

- Coordination with other agencies, including the need for agreements with parties other than USEPA required for construction and operation of the remedy;
- Availability of necessary equipment, specialists, and provisions to assure any necessary resources; and
- Availability of services and materials, plus the potential for obtaining competitive bids.

10.6.1 Mine Area Residences Alternatives

Alternatives 1-1 and 1-4 would be readily implementable. Alternatives 1-2 and 1-3 include implementation of institutional controls. Implementation of institutional controls would require coordination with state and local governments and the property owner. Implementation and enforcement could be difficult depending on the type of control. If the institutional control is a form of governmental control, such as a zoning restriction, ordinance, or statute, the institutional control would be implemented and enforced by the state or local government. Proprietary controls, such as easements and covenants placed in the chain of titles, can be complicated to implement and must consider the individual rights of the property owner with respect to his or her property. Enforcement agreements are only binding on the signatories and the property restrictions are not transferred through a property transaction. Informational devices are not directly enforceable and may be used in a layered strategy of implementing institutional controls for greater effectiveness.

10.6.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives

The no-action alternative, Alternative 2-1, would be readily implementable. Of the alternatives involving active remediation, Alternatives 2-2, 2-3, and 2-4 would be more easily implemented than Alternatives 2-5 and 2-6.

Ferric chloride coagulation/filtration treatment systems, a common component to Alternatives 2-2 through 2-6, have been designed and operated at full-scale at other projects within the United States and equipment is readily available from commercial vendors. Additional data on the flow rates of the adit and buttress seepages would need to be collected prior to design. The operation and monitoring requirements of a ferric chloride coagulation/filtration process, including the need for a part-time operator, require that a long-term access plan for the site be developed.

Construction activities employed in Alternatives 2-2 through 2-6 would use available equipment, labor, and materials that would be provided by an environmental contractor. However, the remote location and steep topography would make access by large construction equipment difficult and would require road improvements to existing access roads and construction of new access roads. Technical challenges exist for the excavation of tailings under Alternatives 2-5 and 2-6. Excavation activities would require significant handling of contaminated material; engineering measures to dewater tailings; collection, storage, and treatment of water removed during excavation; and significant earthwork to restore Little Clipper Creek channel and move waste rock outside of the 100-year flow. Alternative 2-5 includes construction of an onsite disposal cell. A disposal cell location has been identified that appears to have appropriate topography to accommodate the volume of tailings removed during excavation activities. The steep topography and remote location would present technical challenges related to placement of liners and access by construction equipment. The ground would require preparation for placement of leak detection and leachate collection piping and placement of an impermeable liner. The construction of an onsite disposal facility would have implications on the future land use of the site. Under Alternative 2-6, approval of an offsite disposal facility and offsite transport of contaminated tailings could present significant administrative challenges to implementation.

Implementation of institutional controls is included in all alternatives except the no-action alternative. Implementation of institutional controls would require coordination with state and local governments and the property owner(s). Alternative 2-6 includes the least restrictions on land use.

10.6.3 Little Clipper Creek Alternatives

The no-action alternative, Alternative 3-1, would be readily implementable. Soil cover placement, channel construction, and/or excavation employed in Alternatives 3-3 and 3-4 would be implementable; the equipment, labor, and materials are readily available. Technical challenges do exist regarding construction in the stream channel. Construction activities under Alternatives 3-3 and 3-4 would require that an access road be built upstream of Tensy Lane and would require coordination with multiple property owners. To avoid removing large diameter trees and to reduce impact on riparian habitat, excavation of sediment under Alternative 3-3 or 3-4 may need to be conducted by hand crews rather than using heavy equipment.

In Alternative 3-3, construction of the Little Clipper Creek channel would require excavation of a greater volume of sediment than the estimated volume of contaminated soil and sediment excavated and disposed offsite under Alternative 3-4.

Implementation of institutional controls under Alternatives 3-2 and 3-3 would require coordination with state and local governments and multiple property owners. Implementation and enforcement of institutional controls can be difficult depending on the type of control. Multiple parcels of property include portions of Little Clipper Creek upstream of Greenhorn Road and access to Little Clipper Creek is readily available from Greenhorn Road and Tensy Lane.

10.7 Cost

This criterion addresses the total cost of each alternative. This includes short-term and long-term costs, and capital and O&M costs. The following cost elements are considered for each alternative:

- **Capital Cost.** Direct capital cost includes the cost of construction, labor, equipment, land, site development, and service. Indirect capital cost includes engineering fees, license and permit cost, startup and shakedown costs, and contingencies.

- **Replacement Cost.** Replacement cost includes the complete on-time replacment of the water treatment plant which is common to all alternatives excepting the "no-action" and "institutional control only" alternatives.

- **O&M Cost.** Annual O&M cost includes operating labor cost, maintenance materials and labor, pumping and treatment energy costs, monitoring costs, and all other post-construction costs necessary to ensure continuous effective operation of the alternative.

- **Total Present Worth.** The total present worth of each alternative is calculated at a discount rate of 3.2 percent and a maximum time period of 50 years. Total present worth for each alternative includes capital cost plus the present worth of the annual O&M costs.

The cost estimates are considered order-of-magnitude level estimates (i.e., the cost estimates have an expected accuracy of +50 to -30 percent).

10.7.1 Mine Area Residences Alternatives

Alternative 1-4 would be the most expensive remedial alternative for the mine area residences (see Table 13). Of the disposal options considered for Alternative 1-4, offsite disposal would be the most expensive option (net present value estimated as $500,000), followed by onsite disposal ($350,000), and consolidation with the tailings for grading or capping would be the least expensive disposal option ($310,000).

Alternative 1-3 has an estimated net present value of $250,000. Major costs of both Alternatives 1-4 and 1-3 include purchase of uncontaminated soil for the cover or for backfill. Alternative 1-2 has an estimated net present value of $46,000 for implementation and maintenance of institutional controls. No cost is associated with the no-action alternative.

10.7.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Alternatives

No cost is associated with the no-action alternative (Alternative 2-1). The net present value for each alternative is summarized in Table 13. The total net present value of each alternative is presented for both a low-flow and a high-flow scenario. As indicated in Table 13, the costs of alternatives for the mine area increase by increasing active remediation, with Alternative 2-2 being the least expensive and Alternative 2-6 the most expensive alternative evaluated. If the tailings failed soluble toxicity limit

TABLE 13
Cost Summary of Remedial Alternatives
Lava Cap Mine Site – Mine Area OU ROD

Subarea		Alternative	Capital Cost ($)	Annual O&M Cost ($)	Present Value for Equipment Replacement Cost ($)	50-Year Present Value [a] ($)
Mine Area Residences	1-1	No Action	0	0		0
	1-2	Institutional Controls	34,000	480		46,000
	1-3	Capping	190,000	2,200		250,000
	1-4	Excavation				
		1-4A Consolidate with Tailings	310,000	0		310,000
		1-4B Offsite Disposal	500,000	0		500,000
		1-4C Onsite Disposal	340,000	190		350,000
Mine Buildings, Tailings, Waste Rock, and Mine Drainage	2-1	No Action	0	0		0
	2-2	Surface Soil Controls and Buttress Construction [b]	2,900,000	23,000		3,400,000
		2-2A Low-Flow Treatment	1,070,000	70,400	485,000	3,300,000
		2-2B High-Flow Treatment	3,330,000	125,000	1,520,000	7,900,000
	2-3	Capping and Buttress Construction [b]	4,600,000	30,000		5,400,000
		2-3A Low-Flow Treatment	1,070,000	70,400	485,000	3,300,000
		2-3B High-Flow Treatment	3,330,000	125,000	1,520,000	7,900,000
	2-4	Capping, Solidification, and Buttress Construction [b]	5,600,000	29,000		6,300,000
		2-4A Low-Flow Treatment	1,070,000	70,400	485,000	3,300,000
		2-4B High-Flow Treatment	3,330,000	125,000	1,520,000	7,900,000
	2-5	Excavation and Onsite Disposal [b]	7,500,000	37,000		8,400,000
		2-5A Low-Flow Treatment	1,070,000	70,400	485,000	3,300,000
		2-5B High-Flow Treatment	2,400,000	99,300	1,090,000	5,900,000
	2-6	Excavation and Offsite Disposal [b]	11,000,000	18,000		11,000,000
		2-6A Low-Flow Treatment	1,070,000	70,400	485,000	3,300,000
		2-6B High-Flow Treatment	2,400,000	99,300	1,090,000	5,900,000
Little Clipper Creek	3-1	No Action	0	0		0
	3-2	Institutional Controls	1,400	12,000		290,000

TABLE 13
Cost Summary of Remedial Alternatives
Lava Cap Mine Site – Mine Area OU ROD

Subarea		Alternative	Capital Cost ($)	Annual O&M Cost ($)	Present Value for Equipment Replacement Cost ($)	50-Year Present Value [a] ($)
	3-3	Capping and Channelization	680,000	14,000		1,000,000
	3-4	Excavation				
		3-4A Consolidate with Tailings	300,000	8,100		500,000
		3-4B Offsite Disposal	430,000	8,100		630,000
		3-4C Onsite Disposal	330,000	8,300		530,000

Note:

[a] Net present value estimates use a real discount rate of 3.2 percent. Net present value estimates for Alternatives 2-2 through 2-6 include one replacement of treatment capital equipment at Year 25.

[b] Cost does not include the cost of treatment of mine area seeps. The costs for water treatment are shown separately for a low- and high-flow scenario.

concentration (STLC) testing and required disposal as a non-RCRA hazardous waste, the offsite disposal cost under Alternative 2-6 would increase by the contingency cost shown in Table 13. All alternatives involving active remediation include collection and treatment of the mine area seeps.

Capital and O&M costs of treatment are sensitive to the actual flow rates and arsenic concentrations of the adit and buttress seepages because of factors such as equipment sizing, chemical usage, and sludge production and disposal. Costs of treatment were developed for a low-flow and high-flow scenario for all alternatives.

Under the low-flow scenario for all alternatives, the equipment capital cost treatment is estimated as $1,070,000, and annual O&M costs are estimated as $70,400. For the high-flow scenario for Alternatives 2-2, 2-3, and 2-4, the equipment capital cost is estimated as $3,300,000, and annual O&M costs are estimated as $125,000. For the high-flow scenario for Alternatives 2-5 and 2-6, in which the tailings pile seeps are eliminated, the equipment capital cost is estimated as $2,400,000 and annual O&M costs are estimated as $99,300.

10.7.3 Little Clipper Creek Alternatives

Alternative 3-3 would be the most expensive remedial alternative for Little Clipper Creek (Table 13). The net present value of Alternative 3-3 is estimated as $1,000,000. Construction of the Little Clipper Creek channel is the most expensive component of Alternative 3-3. The cost estimate for Alternative 3-4 includes three disposal options. Offsite disposal would be the most expensive option (net present value estimated as $630,000), followed by onsite disposal ($530,000), and consolidation with the tailings for grading or capping would be the least expensive disposal option ($500,000).

Major costs of both Alternatives 3-3 and 3-4 include purchase of uncontaminated soil (for either the cap or backfill, respectively), construction of an access road upstream of Tensy Lane, and road maintenance for existing roads. Alternative 3-2 has an estimated net present value of $290,000 for implementation and maintenance of institutional controls and surface-water monitoring. No cost is associated with the no-action alternative (Alternative 3-1).

10.8 State Acceptance

In a letter dated March 24, 2004, the California Department of Toxic Substances Control, as lead agency for the State, accepted USEPA's selected remedy.

10.9 Community Acceptance

USEPA received several written comment on the Proposed Plan during the 30-day public comment period. In addition, considerable oral comment was received at the public meeting held on February 26, 2004. The oral comments that were not responded to directly at the public meeting and all of the written comments received, along with USEPA's responses to them, are presented in the Responsiveness Summary (Part III of this ROD). The full transcript for the public meeting is also included in the Responsiveness Summary.

In the development of this ROD, USEPA carefully considered all of the comments submitted. Most of the comments received were either neutral or favorable toward USEPA's proposed cleanup. A few concerns were raised or suggestions offered by commenters on how best to accomplish various aspects of the cleanup, but none rejected USEPA's proposal. (See the Responsiveness Summary for further discussion of these issues.) Consequently, this ROD carries forth and adopts the preferred alternative published in the Proposed Plan. USEPA will continue to work with local stakeholders during the design process to ensure that any concerns regarding implementation of the remedy, should they arise, continue to be addressed.

11 Principal Threat Wastes

USEPA investigated the Mine Area for contamination from various metals, arsenic, and cyanide because they are used in the mining and processing of ore. The investigation showed that arsenic is the most prevalent contaminant at the Site and presents the most significant risk to human health and the primary risk to ecosystem health. As a result, arsenic was the primary contaminant considered in developing the alternatives for cleaning up the Site, although the same alternatives also address the other contaminants found at the Site. Both USEPA and the State of California consider arsenic a known human carcinogen. Potential non-cancer health effects from exposure to arsenic may include damage to tissues including nerves, stomach, intestines, and skin.

Sampling of several subareas of the Mine Area indicated that tailings-impacted areas contained higher levels of arsenic than surrounding areas. For comparison, arsenic levels in nearby natural soils were about 20 ppm and about 25 ppm in nearby sediments unaffected by the mine tailings. By far the highest levels of arsenic at the Site were detected in sediments at the adit (up to 34,000 ppm) and in and around the cyanide and mill buildings (up to 31,200 ppm in soil and 14,300 ppb in ponded water). Arsenic levels in the waste rock and tailings pile are highest at the surface, averaging 1,340 ppm, and decreasing with depth to 223 ppm in the deepest sample. The estimated volume of tailings and waste rock is 210,000 cy, of which about 50,000 cy is tailings. Soils around the two residences closest to the tailings pile also showed levels of arsenic (1,750 ppm and 1,230 ppm) much higher than normal for the area, and soil at a third residence showed somewhat elevated levels. Surface water from the collapsed adit and from seeps in the tailings pile and at the log dam all showed elevated arsenic concentrations, the highest level detected being 910 ppb detected at the adit during the low-flow period of late summer and early fall. Finally, one of four air samples collected in the tailings area contained arsenic exceeding the USEPA preliminary screening level.

Arsenic was present in the ore mined at the Site, and remained in the tailings after processing. The tailings were placed, uncovered, in the adjacent Little Clipper Creek drainage. Arsenic also occurs in water at the Site: oxidation in the underground rock or in the tailings, combined with surface and groundwater intrusion, results in the release of dissolved arsenic. Surface water flows, such as, notably, the January 1997 flood but also more normal surface water flows, including those coming from the adit, can transport both the dissolved arsenic and arsenic-contaminated tailings downstream away from the source area. Arsenic present in the uncovered tailings can also become airborne as dust during the dry conditions of summer. Thus, the arsenic-contaminated mine tailings present the principal contaminant source and the principle threat from the Site. USEPA considers these tailings to represent a principal threat waste. This source material is highly toxic and highly mobile and, as USEPA's HHRA for the Site shows, presents a significant risk should exposure occur.

12 Selected Remedy

After considering CERCLA's statutory requirements, the detailed comparison of the alternatives using the nine evaluation criteria, and public comments, USEPA, in consultation with the State of California has determined that the most appropriate remedy for this site includes:

> Alternative 1-4 - Excavate contaminated soil around the three remaining Mine Area residences (the fourth will be demolished under Alternative 2-3); backfill the excavated areas with soil transported from an offsite borrow source and subjected to chemical analysis to ensure compliance with the cleanup goals cited in Section 8; and consolidate excavated material to the tailings disposal area for long-term management.
>
> Alternative 2-3 - Consolidate, regrade, and cap the tailings with a low-permeability engineered cover system; contour, cover and revegetate the waste rock disposal area to promote runoff and reduce surface infiltration; replace the failed log dam with a rock buttress; divert clean surface water flows around the tailings and waste rock disposal areas; collect and treat contaminated water emanating from the mine (i.e. the mine drainage) and from the tailings pile (i.e. the seeps); discharge the treated water to Little Clipper Creek; remove tanks, vats, sumps, and contaminated soil from mine buildings, consolidating this material with the mine tailings or shipping it offsite for disposal; and implement land use restrictions to protect the Selected Remedy from physical disturbance and prohibit residential use of land parcels where such use is inconsistent with the Selected Remedy (such land use restrictions shall be implemented as land use covenants under California civil code, Section 1471 (c)).
>
> Alternative 3-4 - Excavate the tailings and arsenic-contaminated sediment which has accumulated along Little Clipper Creek adjacent to Tensy Lane as far south as Greenhorn Road; regrade the excavated areas of the stream channel; and consolidate excavated material to the tailings disposal area for long-term management

12.1 Summary of Rationale for the Selected Remedy

USEPA finds that the alternatives listed in Section 9, for each portion of the remedy except the "no action" (Alternatives 1-1, 2-1, and 3-1) and "institutional controls only" alternatives (Alternatives 1-2 and 3-2), would generally satisfy the threshold requirements (i.e. provide adequate protectiveness and in most cases meet ARARs). Beyond the adequacy of the alternatives to meet threshold criteria, the other factors that differentiate the cleanup alternatives are described below.

For the Mine Area Residences, as discussed above, Alternatives 1-1 and 1-2 do not meet the threshold requirements and therefore are eliminated from further consideration. Between the two remaining alternatives (1-3 and 1-4), USEPA's analysis concludes that Alternative 1-4 (Excavation Around Residences) is superior to Alternative 1-3 (Capping Around Residences) because of the following reasons:

> • Long-term Effectiveness and Permanence: By physically removing soil contaminated at levels above the soil cleanup goal from residential areas, Alternative 1-4 permanently eliminates the risk pathway, thereby achieving the greatest possible degree of long-term effectiveness. In contrast, under Alternative 1-3 waste is left in place and must be managed in the long term through inspection and maintenance of the soil cover, and through land use restrictions. Land

use restrictions are generally considered less reliable than physical measures because individuals unaware of use restrictions may still come in contact with Site related contaminants.

• Implementability: Although both Alternatives 1-3 and 1-4 rely on readily employed construction measures (fill and excavation, respectively), Alternative 1-4 requires no further measures beyond construction, and therefore its implementation concludes upon completion of construction. In contrast, Alternative 1-3 relies on land use restrictions in the form of a deed restriction preventing activities that would damage the soil cover and/or exposed the underlying Site related contaminants.

• Cost: As Alternatives 1-3 and 1-4 are very close in 50 year net present value cost ($250,000 and $350,000 respectively), the additional long-term effectiveness and implementability of Alternative 1-4 do not come at significant additional cost, therefore Alternative 1-4 is considered highly cost-effective.

For the Mine Buildings, Tailings, Waste Rock, and Mine Drainage alternatives, as discussed above, Alternative 2-1 does not meet the threshold requirements and is therefore are eliminated from further consideration. Alternatives 2-3 and 2-4 have in common the same elements except for the inclusion of cement stabilization of a portion of the tailings under Alternative 2-4; because Alternative 2-4 is more costly and does not result in any improvement in meeting Remedial Action Objectives, Alternative 2-4 is elminated from further consideration. The four remaining alternatives (2-2, 2-3, 2-5, and 2-6) share the same water treatment components in common, therefore there are no differneces to evaluate pertaining to water treatment. Between the four remaining alternatives, USEPA's analysis concludes that Alternative 2-3 (Capping, Buttress, Water Treatment) is superior to the other alternatives for the following reasons:

• Implementability: Alternative 2-6 (Offsite Disposal) is considered unimplementable due to: the large number of truckloads of material that would need to be hauled offsite; the associated hazards of handling, preparing, and shipping the fine-grained mine tailings; the residential nature of land use along likely haulage routes which could raise nuisance impacts to the surrounding community. In contrast Alternatives 2-2 (Surface Controls, Buttress, Water Treatment), 2-3 (Capping, Buttress, Water Treatment), and 2-5 (New Onsite Disposal Cell, Water Treatment) would all manage the waste onsite and utilize common construction practices. Each of these three alternatives would require some form of land use restriction. However, Alternative 2-5 would require more material handling than Alternatives 2-2 and 2-3, including extensive dewatering procedures, the necessity of large staging areas for dewatering and preparation for transport to the new disposal cell, and the haulage of the tailings to the new disposal cell requiring a similar number of truckloads as would be required under Alternative 2-6. This combination of factors under Alternative 2-5 increases the potential for airborne transport of the fine-grained mine tailings, potentially resulting in an exposure hazard to workers and nearby residential populations. For these reasons, USEPA considers Alternatives 2-2 and 2-3 superior to the other alternatives.

• Short-term Effectiveness: Again, due to the amount of material handling required by Alternatives 2-5 and 2-6, and the associated potential for short-term exposure of workers and nearby residential populations to airborne tailings, as discussed above, USEPA considers Alternatives 2-2 and 2-3 superior.

• Long-term Effectiveness and Permanence: Alternative 2-2 ranks much lower than Alternatives 2-3, 2-5, and 2-6, in permanence due to the fact that the soil cover system is the least robust, consisting of one foot of soil plus vegetation, which is more easily subject to environmental degradation in the form of erosion, root intrusion from plants, and excavation by burrowing animals. It also presents less of a barrier to human intrusion (Alternatives 2-3 and 2-5 include thicker soil covers and high density polyethlene membranes which in combination are more difficult to breach). Alternative 2-2 also ranks lower in groundwater protectiveness because it does not include a low permeability barrier as do Alternatives 2-3 and 2-5. Alternative 2-5 would be predicted to be superior to Alternative 2-3 at reducing leachate generated by the tailings during the first years of implementation, however USEPA believes in the long term Alternative 2-3 will meet a similar standard of groundwater protectiveness by minimizing the generation of leachate through the placement of surface water controls in combination with the capping of the tailings with an engineered low permeability cover system, and by collecting any leachate that may occur for treatment. Alternative 2-5 involves constructing a new landfill cell on currently uncontaminated property while attempting to restore the Little Clipper Creek stream channel; Alternative 2-3 caps the waste in place but does not impact currently uncontaminated property. Alternative 2-6 ranks highest in long term effectiveness and permanence because removing the mine tailings to an offsite disposal facility eliminates the need to manage this waste in place and results in fewer land use restrictions; however, as discussed above, USEPA considers Alternative 2-6 unimplementable. Therefore USEPA believes Alternatives 2-3 and 2-5 are the highest rated implementable alternatives under this criteria.

• Cost: In rank of cost from least to highest, the fifty year net present value of the four alternatives being considered is as follows: Alternative 2-2 ($10.7 million); Alternative 2-3 ($12.7 million); Alternative 2-5 ($14.1 million); and Alternative 2-6 ($16.7 million). Although Alternative 2-2 ranks lowest in terms of cost, due to concerns about its permanence, USEPA believes Alternative 2-3 provides the best balance of cost in combination with long term and short term effectiveness.

For the Little Clipper Creek alternatives, as discussed above, Alternatives 3-1 and 3-2 do not meet the threshold requirements and therefore are eliminated from further consideration. Between the two remaining alternatives (3-3 and 3-4), USEPA's analysis concludes that Alternative 3-4 (Excavation) is superior to Alternative 3-3 (Capping) because of the following reasons:

• Long-term Effectiveness and Permanence: By physically removing sediment contaminated at levels above the sediment cleanup goal from residential areas, Alternative 3-4 permanently eliminates the risk pathway, thereby achieving the greatest possible degree of long-term effectiveness. In contrast, under Alternative 3-3 waste is left in place and must be managed in the long term through inspection and maintenance of the sediment cap, and through land use restrictions.

• Implementability: Although both Alternatives 3-3 and 3-4 rely on readily employed construction measures (capping and excavation, respectively), Alternative 3-4 requires no further measures beyond construction, and therefore its implementation concludes upon completion of construction. In contrast, Alternative 3-3 relies on land use restrictions in the form of a deed restriction preventing activities that would damage the sediment cap and/or exposed the underlying Site related contaminants; such restrictions rely upon the knowledge and compliance of the property owner. Although hauling the excavated sediment back to the tailings disposal area is necessary under Alternative 3-4, the amount of material to be moved is manageable and is estimated at 2000 cubic yards, a volume approximately 4% as large as that contained in the tailings disposal area itself. Alternative 3-4 would involve trucking the tailings back to the mine using the immediately adjacent mine access road. Alternative 3-3 would also involve truck traffic, in this case to import fill to areas of Little Clipper Creek to be capped; this material would have to be brought in using Greenhorn Road, which traverses residential areas.

• Cost: Alternative 3-4, which is superior in terms of the criteria discussed above, is also less costly than Alternative 3-3 (the fifty year net present values for the two alternatives are $500,000 and $1,000,000 respectively).

As described in Section 11, USEPA has designated the arsenic-contaminated tailings as a principal threat waste at the Site. This designation is based on the tailings containing elevated concentrations of highly toxic materials (arsenic) and being highly mobile when contacted by and eroded by surface water flows. The tailings represent a significant risk to human health or the environment should exposure occur (or continue to occur). The volume of tailings and expense of treating the tailings to remove the arsenic make physical treatment impracticable. The preference stated in the NCP is that USEPA address principal threats wherever practicable, preferably through treatment (NCP Section 300.430(a)(1)(iii)(A)). Although the tailings will not be treated, these principal threat wastes will be addressed through excavation (from around the Mine Area residences, in the Little Clipper Creek channel, and areas surrounding the tailings/waste rock pile) and containment (construction of the rock buttress, a low-permeability cap, and channelization of surface water). These activities will significantly reduce the potential future migration of and exposure to the tailings. In addition, the cap to be installed over the tailings along with the surface water control features, will greatly reduce potential transport of the arsenic away from the principal threat waste by reducing infiltration. Institutional controls plus access restrictions will also minimize potential exposure to the principal threat waste and prevent interference with the long term effectiveness of the remedy.

The selected remedy, Alternatives 1-4, 2-3, and 3-4, meets the two Superfund threshold evaluation criteria, overall protection of human health and the environment and compliance with ARARs, and provides the best balance of the remaining Superfund evaluation criteria.

12.2 Description of the Selected Remedy

The components of the selected remedy (see Figure 9/Selected Remedy Details) are as follows:

Mine Area Residences

- Demolish the residence located on parcel 39-160-25, referred to in this ROD as the Upper Rental, which was constructed on waste rock and/or tailings;
- Achieve cleanup goals by excavating arsenic-contaminated soil from the following three parcels on which individual residences are located, with the goal of returning the parcels to residential use: 39-160-16; 39-160-21; and 39-160-30;
- Consolidate excavated soil under the tailings pile engineered cover system for long-term management (see desciption of tailings management under Mine Buildings, Tailings, Waste Rock, and Mine Drainage, below); and

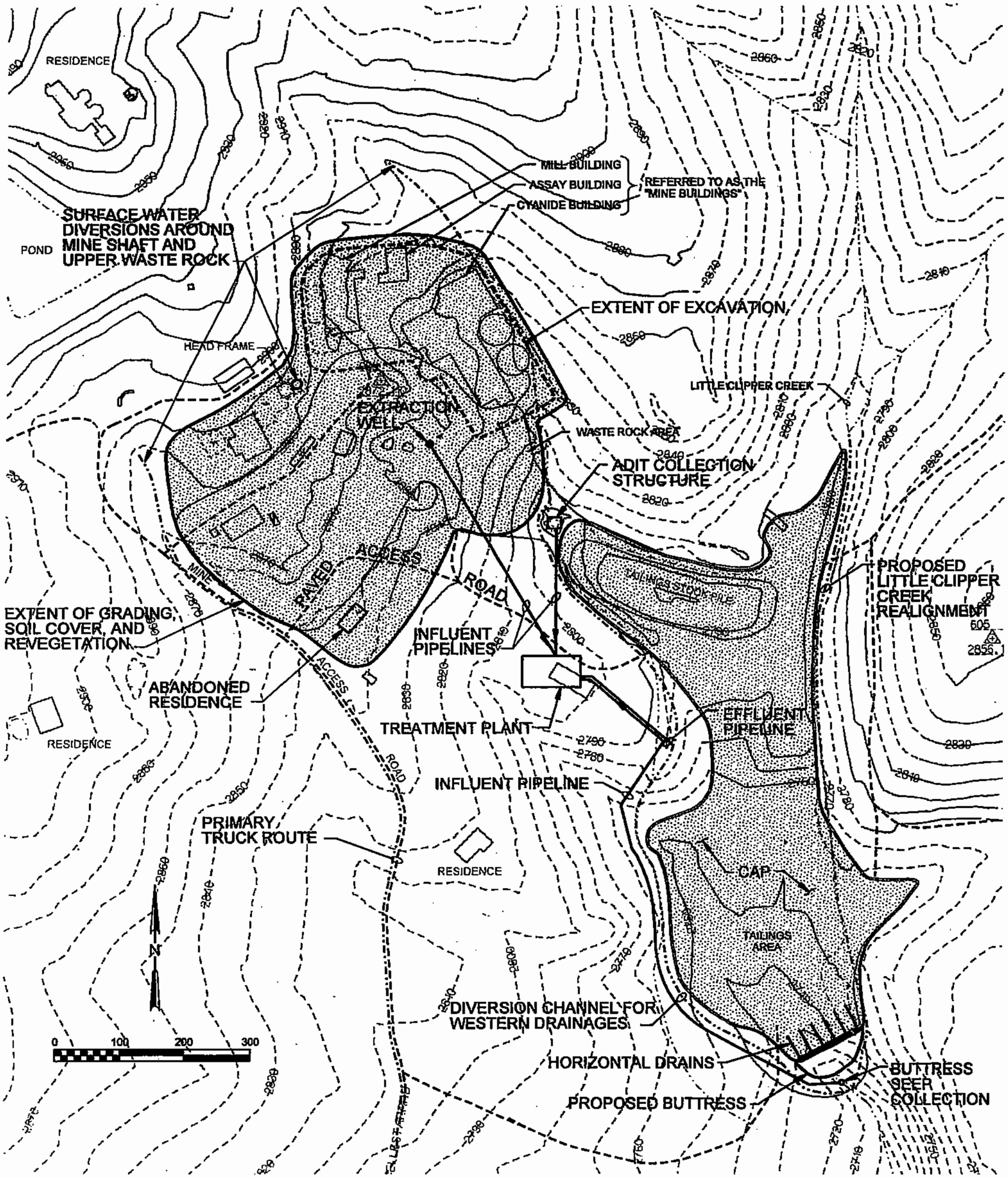


FIGURE 9
SELECTED REMEDY DETAILS
LAVA CAP MINE
NEVADA COUNTY, CALIFORNIA

- Backfill the excavated areas with soil transported from an offsite borrow source and subjected to chemical analysis to ensure compliance with the cleanup goals cited in Section 8; revegetate similar to pre-existing conditions.

Mine Buildings, Tailings, Waste Rock, and Mine Drainage

Institutional Controls

- Restrict unauthorized access by requiring deed restrictions limiting access and preventing residential, commercial, industrial, or recreational use of parcels 39-160-25 and 39-160-28;
- Require deed restrictions to prevent intrusive activities such as construction or excavation of any type that may disturb the Selected Remedy on parcels 39-160-25 and 39-160-28;
- Require deed restrictions to prevent alteration of or intereference with the operation of the Little Clipper Creek diversion structure partially located on parcel 39-160-27;
- Require deed restrictions to prevent alteration of the asphalt cap placed on exisiting gravel roadways on parcels 39-160-29; 39-160-25; and 39-160-30; and

Mine Buildings

- Restrict unauthorized access through the intallation of chain link fencing at portions of the Site including the mine buildings;
- Achieve cleanup goals through the excavation of contaminated soil in and around the cyanide, mill, and assay buildings;
- Reduce or eliminate hazards in the cyanide, mill, and assay buildings, including removal of soil and debris associated with former process tanks, removal of cyanide vats, and removal of sumps; and
- Subject material from the cyanide, mill, and assay buildings, to chemical analysis and consolidate material onsite or send offsite to an appropriate offsite disposal facility.

Tailings

- Restrict unauthorized access through the intallation of chain link fencing at portions of the Site including the tailings areas capped as part of the Selected Remedy;
- Regrade the tailings to flatten slopes;
- Achieve cleanup goals by excavating contaminated soil located around the periphery of the waste rock and tailings piles and consolidating this material under the tailings pile engineered cover system for long-term management;
- Cap the tailings with a low-permeability engineered cover system, to include a minimum six inch sand layer placed over the re-graded tailings, a 60-mil thick HDPE liner, a minimum two foot soil cover over the HDPE liner, plus shallow-rooted surface vegetation to maintain the cover system's resistance to erosion;
- Remove the remnants of the log dam and construct in its place a rock buttress capable of withstanding a horizontal ground acceleration of 0.3 g (where g is the force of gravity); to be

constructed approximately 20 feet in height with a downstream slope of 2.5 : 1 (horizontal to vertical dimension) and placed directly on bedrock; to include a 60-mil thick HDPE liner placed against the upstream (or tailings) side of the buttress and a sand drain placed on top of the HDPE liner to prevent seepage through the buttress to the downstream side;

- Install horizontal drains beneath the surface of the tailings and at the upstream (or tailings) side of the buttress to dewater the tailings and collect any leachate generated by the tailings for piping to the water treatment plant to be constructed as part of the Selected Remedy;
- Install a channel to divert Little Clipper Creek along the eastern boundary of the tailings pile; to be constructed to accommodate storm flows of a 100-year return frequency; to be constructed of rock gabions and a 60-mil thick HDPE liner; to be constructed 5 feet wide at the base and five feet in depth, with side slope dimensions of 2 : 1 (horizontal to vertical dimension);
- Construct diversion channels for the western drainage that occurs adjacent to the mine buildings and for the seasonal surface water flow that occurs along the western boundary of tailings pile; to be constructed to accomodate storm flows of a 100-year return frequency; to be constructed of rock gabions and a 60-mil thick HDPE liner; require deed restrictions on parcels 39-160-25 to prevent alteration of the diversion channel; and
- Conduct periodic monitoring of surface water and groundwater downgradient of the tailings pile to assess compliance with cleanup goals.

<u>Waste Rock</u>

- Restrict unauthorized access through the intallation of chain link fencing at portions of the Site including waste rock areas capped as part of the Selected Remedy;
- Construct shallow rip-rap lined surface water diversion structures above the mine shaft and waste rock areas to reduce infiltration into the system of shafts and tunnels and thereby potentially reduce the volume of adit seepage;
- Regrade the waste rock to facilitate runoff and reduce surface-water infiltration;
- Cover the regraded waste rock with one foot of soil and vegetation; and
- Pave the primary access roads (which appear to have waste rock based components) on the mine property, including a road to the surface water treatment plant, to reduce dust emissions.

<u>Mine Drainage</u>

- Restrict unauthorized access through the intallation of chain link fencing at portions of the Site including water treatment collection, piping, and treatment facilities installed as part of the Selected Remedy;
- Pump water out of the mine workings to reduce or eliminate discharge from the adit; pipe extracted mine water to the water treatment plant to be constructed as part of the Selected Remedy;
- Construct an adit structure to measure seepage flow rates and to collect any remaining adit seepage not captured by pumping from the mine workings; subject material excavated from the adit as part of

construction to chemical analysis and consolidate onsite or ship offsite to an appropriate disposal facility;

- Construct a water treatment plant to treat surface water collected from the mine workings and/or adit and from the mine tailings; treatment to consist of a ferric chloride coagulation/filtration process or alternative innovative technology if demonstrated feasible and cost effective in comparison to the ferric chloride coagulation/filtration process; and

- Conduct periodic monitoring of surface water in Little Clipper Creek upstream and downstream of the mine area to assess compliance with cleanup goals.

Little Clipper Creek

- Achieve cleanup goals by excavating arsenic-contaminated soil/sediment from Little Clipper Creek channel and adjacent deposition areas;

- Subject excavated tailings to chemical analysis and consolidate material onsite or ship offsite to an appropriate disposal facility;

- Grade the excavated area to re-establish the Little Clipper Creek channel, stabilize the channel bed and banks, and revegetate similar to pre-existing conditions;

- Construct temporary roads to provide access to extent of areas requiring excavation, to be removed following completion of construction activity; and

- Continue to conduct surface-water monitoring in Little Clipper Creek within and downstream of the boundaries of the Mine Area Operable Unit to assess compliance with cleanup goals.

The actual technologies to be used in implementing the remedy will be determined during remedial design. Minor modifications to the remedy may also occur during remedial design or construction. However, public notice would be given by USEPA if there were any significant changes to the remedy, and any fundamental changes would be subject to public comment.

Additional technical details on each component of the selected remedy, including cleanup or design criteria and compliance are provided in the following sections.

12.2.1 Mine Area Residences Cleanup Criteria

- All soil contaminated with arsenic in excess of cleanup goals (see Table 9 for cleanup goals) on the three residential parcels 39-160-16, 39-160-21, and 39-160-30, will be excavated and consolidated with the tailings for long-term management.

- Determination of the areal extent to be excavated will be based on chemical analysis of representative soils collected from multiple locations on each parcel. Visual assessment may be used to identify sampling locations in areas suspected to be contaminated due to the presence of materials resembling the mine tailings; however, sample locations for each of the parcels will be distributed to include areas of the parcels with no immediately discernable visual evidence of tailings.

- Determination of depths of soil to be excavated will be based on further sampling at areal locations determined to have arsenic prsent above cleanup goals. Excavation will be terminated when soil is encountered that meets cleanup goals or at bedrock if encountered.

Compliance with Mine Area Residences Cleanup Criteria

Compliance will be determined using the results of post-excavation, confirmation soil sampling. To confirm that cleanup to background levels (background concentrations are identified as the cleanup goal in Table 9) has been achieved, the post-excavation soil sampling data set will be compared to the surface soil background data set using statistical techniques. USEPA has developed a guidance document that will be used to assist in conducting this statistical comparison: *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites/USEPA 540-R-01-003/September 2002* (USEPA, 2002a).

12.2.2 Mine Buildings, Tailings, Waste Rock and Mine Drainage Design and Cleanup Criteria

This section provides the design criteria and cleanup criteria to be used in designing, constructing, and evaluating performance of the selected remedy. Where appropriate, compliance criteria have been identified also. For some of the components, there are no specific compliance criteria because compliance will be demonstrated by ensuring that the remedial design meets the specified design criteria.

Institutional Controls Requirements

- Provide detailed notification to any tenants or workers on the property regarding the presence of hazardous substances
- Provide detailed notification to any tenants or workers on the property regarding deed restrictions, specifically prohibited activities intended to ensure uninterrupted performance of the Selected Remedy as well as overall protection of human health and the environment.
- Prevent access to the mine buildings.
- Prevent activities that might damage or affect the integrity of the tailings cap, covered waste rock, surface water controls, or the rock buttress.
- Prevent any activities that might interfere with the effectiveness of the Selected Remedy.
- Prevent development or use of the Mine Area for any commercial, industrial, recreational or residential use that would expose any person to contaminated soil or surface water.

<u>Implementation and Compliance with Institutional Control Requirements</u>

Implementation of land use restrictions governed by the above requirements is planned as follows:

- Require deed restrictions to prevent: residential use, a hospital, a public or private school or a day care center, on parcels 39-160-25 and 39-160-28.
- Require deed restrictions to prevent intrusive activities such as construction or excavation of any type that would interfere with the Selected Remedy on parcels 39-160-25 and 39-160-28.
- Require deed restrictions to prevent alteration of or intereference with the operation of the Little Clipper Creek diversion structure partially located on parcel 39-160-27.

- Require deed restrictions to prevent alteration of the asphalt cap placed on exisiting gravel roadways on parcels 39-160-29; 39-160-25; and 39-160-30.

- When developing the long term operations and maintenance plan for the site, include a compliance monitoring system to include periodic site inspections and administrative review of deed restrictions.

Additional language within the deed restrictions is planned to include the following:

- The owner of the aforementioned parcels must give notice of all institutional controls to any lessees of any portion of the Site.

- All land use controls must be recorded and run with the land pursuant to California Civil Code Section 1471(c), CA Health and Safety Code Section 25355.5, or other enforceable legal mechanism, to ensure that the restrictionsare binding on all current and future property owners, their heirs, successors, and assignees, and the agents, employees or lessees of the owners, heirs, successors and assignees.

- The owner must give 6 months prior notice to USEPA before any sale of any portion of the Site.

- The owner must identify to USEPA all lessees on any portion of the Site within 30 days of such lessees occupying any portion of the Site.

Mine Building Design and Cleanup Criteria

- Based on data from the RI, all soil/wastes inside of the mill, assay, and cyanide buildings are considered to be highly-contaminated with elevated levels of arsenic and will be excavated for characterization, following which the material will either be consolidated with the tailings for long-term management or, more likely, disposed of at an appropriate offsite facility.

- Most of the area in the immediate vicinity of the mine buildings is waste rock and will be addressed along with the rest of the stockpiled waste rock (see below). However, the surface soil in the immediate vicinity of the mill, assay, and cyanide buildings appears to have been impacted by processing activities and will be excavated to meet cleanup goals. Determination of the areal extent to be excavated will be based on chemical analysis of representative soils collected from multiple locations. The excavated material will be subjected to chemical analysis for the proper characterization and disposal of the material.

- Any water present in the sumps in the mill and cyanide buildings will be removed, characterized, and either treated to achieve cleanup goals or disposed of in an appropriate offsite facility.

- Physical features that remain from former processing activities, including tanks, vats, and sumps will be inspected to determine if they can be readily removed and disposed. Larger items will be left and decontaminated to reduce Site-related contamination to levels below the cleanup goals established in Section 8 above.

- Following excavation of soil/wastes and conducting any required hazard abatement, the remaining concrete foundations and metal siding will be decontaminated to reduce Site-related contamination to levels below the cleanup goals established in Section 8 above.

- Because some of the soil/wastes from the mine buildings contain significantly elevated contaminant concentrations, these materials will be isolated from the remaining tailings and undergo separate characterization to determine the appropriate disposition of this material: either consolidation onsite of shipment offsite to an appropriate disposal facility.

Compliance with Mine Building Design and Cleanup Criteria

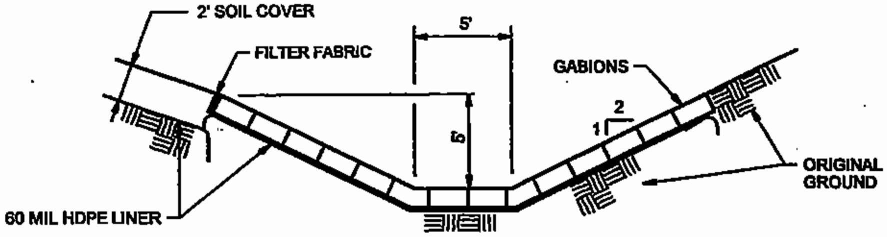
- Soil samples will be collected beyond the area of excavation around the mine buildings to ensure that all of the highly-contaminated materials have been removed. The remaining area will be covered along with the rest of the waste rock. If higher concentrations remain, additional excavation of highly-contaminated materials will be conducted.
- Any of the excavated soil/wastes from within and adjacent to the mine buildings will undergo separate characterization to determine the appropriate disposition of this material: either consolidation onsite of shipment offsiet to an appropriate disposal facility.

Tailings Pile Cap Design and Cleanup Criteria

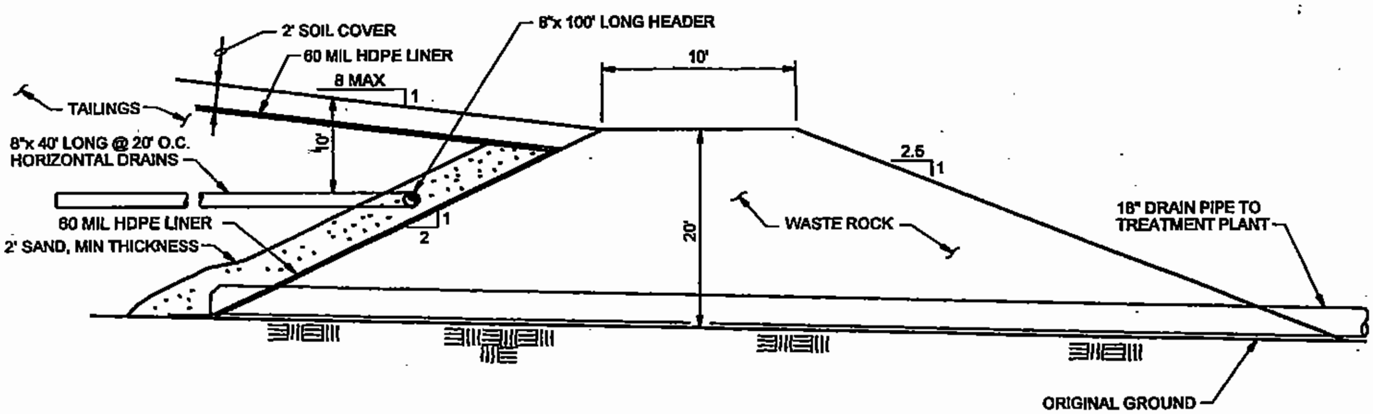
- All areas to be capped shall be graded to slopes of 4:1 or flatter prior to placement of the cap. The cap shall extend across the entire tailings pile area and the adjacent waste rock area (see Figure 9).
- All soil contaminated with arsenic in excess of cleanup goals (see Table 9) in the vicinity of the tailings pile and waste rock areas shall be excavated and consolidated under the tailings pile cap. Determination of the areal extent to be excavated will be based on chemical analysis of representative soils collected from multiple locations. Visual assessment may be used to identify sampling locations in areas suspected to be contaminated due to the presence of materials resembling the mine tailings; however, sample locations will be distributed to include areas with no immediately discernable visual evidence of tailings.
- The tailings cap shall, at a minimum, consist of a 6-inch thick sand layer placed over the tailings, a 60-mil HDPE liner (or equivalent) placed over the sand layer, and 18 inches of low-permeability cover soil plus vegetative cover placed over the HDPE liner.
- The grading and stormwater controls shall be sufficient to ensure that standing water does not accumulate on the vegetated soil cover.
- The vegetation selected for the tailings cap shall be similar to existing vegetation in the area and require minimal irrigation.

Compliance with Tailings Cap Design and Cleanup Criteria

- Compliance will initially be demonstrated during construction by ensuring that the cap meets the minimum thickness criteria presented above.
- As part of long-term O&M, visual monitoring will be conducted routinely to verify the continued integrity of the cap, including confirming that standing water is not present on the cap and monitoring for excessive erosion of the cap.
- For the cleanup of contaminated soil surrounding the tailings/waste rock areas, compliance will be determined using the results of post-excavation, confirmation soil sampling. The same process as described above for the Mine Areas residences excavation will be used to confirm that cleanup to background levels has been achieved.



LITTLE CLIPPER CREEK DIVERSION CHANNEL TYPICAL CROSS SECTION



TYPICAL BUTTRESS CROSS SECTION

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FIGURE 10
CONCEPTUAL DESIGN FEATURES
LAVA CAP MINE
NEVADA COUNTY, CALIFORNIA

Rock Buttress Design Criteria

- From a seismic perspective, the rock buttress shall be designed to achieve internal and external stability under static and pseudo-static conditions. Stability criteria shall include a factor of safety greater than 1.5 under static conditions and 1.1 under pseudo-static conditions.

- The buttress will be placed directly on bedrock following removal of the log dam remnants and the tailings located within and downstream of the buttress footprint. If possible, the buttress will be constructed of onsite waste rock.

- To prevent seepage through the buttress, a liner will be installed on the upstream face of the buttress. A sand blanket drain with an outlet pipe at the base of the buttress will be used to collect seepage. To maintain a dewatered condition directly upstream of the buttress, horizontal drains will be placed in the tailings and connected to the blanket drain for collection and piping to the onsite water treatment plant to be constructed as part of the Selected Remedy. (See Figure 10/Conceptual Design Features.)

- The upstream tailings will be graded and sloped to ensure stability of the pile. The appropriate slope and distance shall be determined during remedial design.

Little Clipper Creek Channel and Western Drainages Channel Design Criteria

- The engineered Little Clipper Creek channel to be installed along the eastern edge of the tailings and waste rock shall extend from upstream of any waste rock/tailings to beyond the rock buttress and be sized to handle the estimated return flow from a 100-year storm event (see Figure 10).

- Similarly, the channel for the western drainages shall be designed to handle the 100-year event and shall direct flow around the upper areas of stockpiled waste rock, past the entire tailings pile, and extending to below the rock buttress (see Figure 9).

- The upstream end of both channels will be excavated and keyed into bedrock to allow capture of subsurface flow through the upper alluvial layer (estimated to be between 2 and 10 feet below ground surface [bgs]) and minimize the possibility of continued flow of surface water into the waste rock.

Waste Rock Design Criteria

- All stockpiled waste rock (see Figure 9) shall be graded to facilitate runoff and reduce surface water infiltration. The waste rock area extends from above the adit north to the area surrounding the mine shaft and mine buildings.

- Following grading, the waste rock shall be covered with at least one foot of soil and vegetated to further reduce infiltration and minimize potential disturbance by human activities.

- Lined surface water diversions shall be installed above the mine shaft and upper end of the waste rock stockpile to reduce flow of surface water into the waste rock and shaft.

Mine Drainage Design and Cleanup Criteria

- If feasible, the preference is to pump water out of the mine workings to maintain the water level in the mine below the mine adit elevation. Pumping from the mine workings is considered a more effective method of reducing mine discharge than simply capturing the surface water as it leaves the adit, plus pumping down the mine workings allows the workings to be used to balance flow to allow for planned (i.e. for maintenance) and unplanned treatment plant outages. Any water pumped from the mine will need to be piped to the treatment plant for treatment. Based on historic information, it is anticipated that, once the upper workings are dewatered, it will require an extraction rate of around 50 gpm to maintain the water level below the adit.

- Even if it proves feasible to pump from the mine workings, a collection structure will be constructed at the adit to collect any incidental seepage. This collection structure will be keyed into bedrock to minimize flow into the waste rock/tailings pile. Because the arsenic concentrations in sediment in the location of the caved-in adit are very high (up to 34,000 ppm), any sediment excavated from this area will be isolated for chemical characterization to determine appropriate handling (i.e. consolidation with the tailings onsite, or shipment to an appropriate offsite disposal facility).

- Seepage collected by the drain system installed on the rock buttress will also need to be pumped to the treatment plant. The seepage flow rates at the buttress are expected to drop considerably after the first few years of operation as the tailings are cutoff from further surface water infiltration.

Compliance with Mine Drainage Design and Cleanup Criteria

- If pumping from the mine workings is implemented, water level readings will be collected regularly to confirm that the water level in the mine is maintained below the adit elevation.

- If the excavated sediment from the location of the caved-in adit fails characterization testing, it will be disposed offsite at an appropriate disposal facility and will not be consolidated with the tailings.

Water Treatment System Design and Cleanup Criteria

The remedy includes a treatment system for treating mine drainage (pumped from the workings and/or collected at the adit) and tailings seepage (collected from beneath the capped area by means of collection pipes with a collection structure at a low point near the rock buttress). However, design and construction of the full-scale treatment system will be conducted as a second phase of remedy implementation. As noted previously, this will allow USEPA to evaluate the changes in drainage/seepage flow rates expected from implementation of the tailings pile cap, waste rock cover, and surface water management features (Little Clipper Creek channel, western drainage channel, surface water diversions above the waste rock, and improved adit seepage collection).

Because the flow rates requiring treatment and the arsenic concentrations in the treatment plant influent are unknown, USEPA believes that selection of the treatment technology should be delayed until a subsequent phase of remedial design. The ferric chloride coagulation/filtration treatment process that has been assumed for estimating remedy costs is considered the most reliable, cost-effective approach of the currently available conventional treatment technologies. However, extensive arsenic treatment research is ongoing for both conventional and innovative technologies. During initial remedy implementation, USEPA anticipates conducting additional pilot-level testing of innovative technologies, including adsorptive media treatment technologies, that may have lower capital and operator oversight requirements than the ferric chloride system.

In the FS, USEPA evaluated various potential surface water discharge limits based on current ARARs. These limits are presented in Table 14 below for constituents detected in mine adit discharge or seeps, along with the basis for their selection.

Media	Discharge Limit (ug/L)	Basis for Discharge Limit
Aluminum	200	Secondary MCL
Antimony	6	Primary MCL
Arsenic	10	Primary MCL
Cadmium	2.2	CTR criteria
Copper	9.0	CTR criteria
Cyanide	5.2	CTR criteria
Iron	300	Basin Plan
Lead	2.5	CTR Criteria
Manganese	50	Basin Plan
Mercury	0.05	CTR Criteria
pH	+/- 0.5 of Ambient Level	Background/Basin Plan
Sulfate	250,000	Secondary MCL
Total Dissolved Solids (TDS)	500,000	Secondary MCL

Table 14: Surface Water Treatment Discharge Limits

Water Treatment System Compliance with Design and Cleanup Criteria

- Treatment system effluent will require routine monitoring to ensure that the surface water discharge limits are being met. Water quality results will be compared to the values listed in Table 14 to determine compliance.
- If the ferric chloride coagulation/filtration treatment process is selected, sludge will be generated at the treatment plant. Following dewatering, this sludge will need to characterized (i.e., STLC and TCLP analyses) to determine disposal requirements. It has been assumed, based on available information including site specific data and operational data from exisiting systems within the United States, that the sludge will be able to be disposed as an industrial non-hazardous waste in an offsite Class II disposal facility. However, the final disposition of sludge will be based on the test results.

Monitoring Requirements

Routine monitoring will be required to ensure that the remedy is operating as intended and not resulting in downstream surface water impacts or contributing to groundwater contamination. This will include surface water monitoring in Little Clipper Creek upstream and downstream of the Mine Area during high- and low-flow conditions and following storm events.

Groundwater monitoring wells will be installed downgradient of the tailings pile to provide for long-term monitoring of potential groundwater impacts from the tailings. Ultimately, it is expected that groundwater monitoring related to the Mine Area OU will be coordinated with any groundwater remedial actions (including monitoring) that may be implemented based on the results of the ongoing Groundwater

OU RI/FS. Because arsenic concentrations are already elevated in groundwater beneath the tailings pile, it may be difficult to differentiate between pre-existing conditions and any future groundwater impacts from the tailings pile after remedy implementation. However, USEPA expects to continue to work closely with the State of California during remedy implementation to monitor and evaluate groundwater monitoring data and ensure that the tailings pile is not acting as a long-term source of groundwater contamination.

Another component of the monitoring program will be measuring seepage rates from the adit and buttress to assess performance of the remedy at reducing infiltration into the waste rock and tailings pile. USEPA expects the seepage rates to decline considerably after the first few years of remedy implementation. If the seepage rates do not drop over time, it may indicate that the capping and surface water management components of the remedy are not performing as intended.

12.2.3 Little Clipper Creek Cleanup Criteria

- Deposition areas containing sediment/soil contaminated with arsenic in excess of cleanup goals (see Table 9 for cleanup goals) in or adjacent to the Little Clipper Creek channel between the log dam and Greenhorn Road will be excavated (see following bullets for anticipated extent of excavation; also see Figure 5/Little Clipper Creek Source Areas).
- Determination of the areal extent to be excavated will be based on chemical analysis of representative soil/sediment collected from multiple locations along the designated reaches of Little Clipper Creek. Visual assessment may be used to identify sampling locations in areas suspected to be contaminated due to the presence of materials resembling the mine tailings; however, sample locations for each of the reaches of the creek will be distributed to include areas of the parcels with no immediately discernable visual evidence of tailings.
- Determination of depths of soil/sediment to be excavated will be based on further sampling at areal locations determined to have arsenic prsent above cleanup goals. Excavation will be terminated when soil is encountered that meets cleanup goals or at bedrock if encountered.

Compliance with Little Clipper Creek Cleanup Criteria

Compliance will be determined using the results of post-excavation, confirmation sediment/soil sampling. To confirm that cleanup to background levels (background concentrations are identified as the cleanup goal in Table 9) has been achieved, the post-excavation sediment/soil sampling data sets will be compared to the sediment and surface soil background data sets using statistical techniques. USEPA has developed a guidance document that will be used to assist in conducting this statistical comparison: *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites/USEPA 540-R-01-003/September 2002* (USEPA, 2002a).

12.3 Summary of the Estimated Remedy Costs

A detailed breakdown of the estimated capital, O&M, and present worth costs associated with the selected remedy is included in Table 15. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the selected remedy. Major changes if they were to occur would be documented in the form of

Table 15
Detailed Cost Estimate for the Selected Remedy
Lava Cap Mine Site - Mine Area OU ROD

Component	Quantity	Unit	Unit Cost ($)		Cost ($)
Capital Costs (including Engineering and Management)					**Capital Costs**
Mine Area Residences					
Excavation	1	ls.	$62,000		$62,000
Backfill and Revegetation	1	ls.	$69,500		$69,500
Consolidation w/Tailings Pile	1	ls.	$21,000		$21,000
Contractor Overhead, Mobilization, and Profit			24%		$37,100
Contingency			25%		$47,400
Mine Area Residences Capital Cost Subtotal					$237,000
Engineering and Remedial Design Investigation			21%		$49,700
Construction Management, Licenses/Legal			8%		$23,300
Total Mine Area Residances Capital Costs					***$310,000***
Mine Buildings, Tailings, Waste Rock and Mine Discharge (Mine Source Areas)					
Mine Buildings	1	ls.	$360,000		$360,000
Tailings and Waste Rock	1	ls.	$925,000		$925,000
Buttress Construction	1	ls.	$436,000		$436,000
LCC and Western Drainages	1	ls.	$403,000		$403,000
Adit Collection and Pumping from Mine Workings	1	ls.	$72,000		$72,000
Road Maintenance and Repairs	1	ls.	$68,000		$68,000
				Low-Flow	High-Flow
Treatment Plant - Low Flow	1	ls.	$525,000	$525,000	-
Treatment Plant - High Flow	1	ls.	$1,640,000		$1,640,000
Contractor Overhead, Mobilization, and Profit			24%	$678,000	$949,000
Contingency			25%	$867,000	$1,213,000
Mine Source Areas Capital Cost Subtotal				$4,334,000	$6,066,000
Engineering and Remedial Design Investigation			21%	$908,000	$1,271,000
Construction Management, Licenses/Legal			8%	$426,000	$596,000
Total Mine Source Areas Capital Costs				***$5,670,000***	***$7,930,000***
Little Clipper Creek					
Excavation	1	ls.	$58,600		$58,600
Backfill, Stream Channel and Revegetation	1	ls.	$24,400		$24,400
Consolidation w/Tailings Pile	1	ls.	$18,700		$18,700
Road Maintenance and Repaving	1	ls.	$47,300		$47,300
Contractor Overhead, Mobilization, and Profit			24%		$36,200
Contingency			25%		$46,300
Little Clipper Creek Capital Cost Subtotal					$231,500
Engineering and Remedial Design Investigation			21%		$48,500
Construction Management, Licenses/Legal			8%		$22,700
Total Little Clipper Creek Capital Costs					***$300,000***
TOTAL ESTIMATED CAPITAL COST RANGE :				***$6,280,000***	***$8,540,000***

Equipment Replacement Costs	Quantity	Units	Replacement Cost	Present Worth Cost [1] Low-Flow	High-Flow
Treatment Plant - Low Flow (Replace after 25 years)	1	ls.	$1,070,000	$485,000	
Treatment Plant - Hihg Flow (Replace after 25 years)	1	ls.	$3,330,000		$1,520,000
TOTAL DISCOUNTED REPLACEMENT COST RANGE:				***$485,000***	***$1,520,000***

Table 15
Detailed Cost Estimate for the Selected Remedy
Lava Cap Mine Site - Mine Area OU ROD

Annual Operations & Maintenance Costs	Quantity	Units	Annual Cost ($)	Present Worth Cost [2] ($)	
Mine Area Residences					
No O&M Required					$0
Mine Buildings, Tailings, Waste Rock and Mine Discharge					
Land Use Restrictions (Implement, Inspect)	1	yr.	$2,300		$57,000
Tailings Cap Repair, Tailings/Waste Rock Regrading	1	yr.	$10,900		$270,000
LCC and Western Drainages	1	yr.	$5,043		$125,000
Adit Collection, Mine Pumping, and Buttress Collection	1	yr.	$3,100		$77,000
Surface Water Monitoring	1	yr.	$8,700		$216,000
				Low-Flow	High-Flow
Treatment Plant - Low Flow	1	yr.	$70,400	$1,740,000	
Treatment Plant - High Flow	1	yr.	$125,000		$3,100,000
Total Mine Source Areas O&M Costs				*$2,485,000*	*$3,850,000*
Little Clipper Creek O&M					
Surface Water Monitoring	1	yr.	$8,120		$201,000
Total Little Clipper Creek O&M Costs					*$201,000*
TOTAL DISCOUNTED O&M COST RANGE :				*$2,690,000*	*$4,050,000*
TOTAL ESTIMATED CAPITAL COST:				**$6,280,000**	**$8,540,000**
TOTAL DISCOUNTED REPLACEMENT COST:				**$485,000**	**$1,520,000**
ESTIMATED PRESENT WORTH COST:				**$9,500,000**	**$14,100,000**

Notes

(1) Based on a 3.2% discount rate and the expenditures occurring in 25 years.
(2) Based on a 3.2% discount rate and 50 years of O&M.

Capital cost estimates are not discounted because the construction work will be performed in the early stages of the project. O&M costs are reported as present worth estimates given a 3.2% discount rate for a duration of 50 years.

Cost estimates are based on waste rock/tailings volumes, treatment rates, and treatment plant influent quality estimates that may be refined during remedial design. Cost estimates are expected to be within a +50 to -30% accuracy range.

ls. = lump sum; yr. = year

a memorandum in the Administrative Record file, an Explanation of Significant Differences (ESD) or a ROD Amendment.

The capital cost to construct the selected remedy is estimated at $8.54 million. This cost projection assumes the worst-case water treatment scenario under which high-end flow estimates are used. USEPA is fairly certain that the water treatment component of the remedy cost, which is significant, can be reduced by re-directing clean surface water flows that currently enter the mine waste and thereby become contaminated. Although typically a thirty-year present value cost is calculated for federal Superfund projects, at the request of the State of California, USEPA calculated fifty-year present values for the Mine Area OU remedy. The 50-year present worth is estimated at $14.1 million, again assuming high-flow treatment requirements. As is the practice at federal Superfund sites, these cost estimates are based on an expected accuracy range of -30 to +50 percent. The discount rate used for the fifty-year present value cost projection was 3.2 per cent based on Appendix C of Office of Management and Budget Circular A-94.

12.4 Expected Outcomes of the Selected Remedy

The expected outcomes of the selected remedy are as follows. After implementation of the Mine Area Residences component of the Selected Remedy, which will result in the reduction of soil contamination levels to meet cleanup goals, the parcels which the three remaining Mine Area residences occupy (the fourth will be demolished as part of the Selected Remedy) will be available for residential use. Groundwater use restrictions may be necessary in future for these parcels, however, USEPA is deferring a determination on groundwater use restrictions until completion of the Groundwater Operable Unit Remedial Investigation/Feasibility Study.

After implementation of the Little Clipper Creek component of the Selected Remedy, which will result in: 1) the reduction of sediment contamination levels to meet cleanup goals; and 2) the reduction of surface water contamination levels to meet cleanup goals, the two parcels on which these conditions currently exist will be available for unrestricted surface use. Groundwater use restrictions may be necessary in the future for these parcels, however, USEPA is deferring a determination on groundwater use restrictions until completion of the Groundwater Operable Unit Remedial Investigation/Feasibility Study.

After implementation of the Mine Buildings, Waste Rock, Tailings, and Mine Drainage component of the Selected Remedy, long-term use will be restricted on multiple parcels as discussed above, because waste will remain in place on some parcels, and operational parts of the Selected Remedy will remain in place on other parcels. Neverthless, implementation of the Selected Remedy will result in a greatly reduced potential for further release of contaminated tailings, significantly reducing the threat the mine poses to downstream receptors. Little Clipper Creek will be restored to its beneficial use as a potential drinking water supply. Risks to human and ecological receptors at the Mine Area Operable Unit will be managed through the consolidation, capping and covering of source materials (waste rock and tailings) and the treatment of mine drainage and seeps. Because wastes are left onsite permanently, continuous monitoring and maintenance of the wastes (including the formal Five Year Review process required under CERCLA) will be required for the foreseeable future to ensure long-term protectiveness.